Examining the Effects of Home- and School-Based Early Reading Intervention During the COVID-19 Pandemic on Struggling Readers

by

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Abstract

This dissertation includes two studies that examine the effects of home- and school-based reading intervention during the COVID-19 pandemic in a group of Grade 1 to 3 struggling readers. The first study examined whether different parent- and teacher-related factors had an effect on at-risk children's reading development during the first six months of the COVID-19 pandemic. Seventy Grade 1 English-speaking Canadian children (28 females, 42 males; M_{age} = 6.60, SD = 0.46) who were at-risk for reading difficulties were administered word and pseudoword reading, nonverbal IQ, and phonological awareness tasks before the school closures (February 2020; Time 1). Reading tasks were administered again when they returned to school in September 2020 (Time 2). In April-May 2020, their parents (n = 70) and teachers (n = 40) filled out a questionnaire on the home literacy environment and the frequency of teaching reading and providing reading materials, respectively. Results of multilevel regression analyses showed that children's reading enjoyment and home learning activities predicted both word and pseudoword reading at Time 2. Differentiation of instruction for struggling readers also predicted children's pseudoword reading at Time 2. These findings reinforced the important role of parents in their children's early reading development particularly when the typical agents of instruction (i.e., teachers) have less time and opportunities to interact with their students because of the pandemic.

The second study examined if we could improve struggling readers' reading performance by delivering two theory-driven reading interventions (i.e., phonics + set for variability and phonics + morphology) and whether phonics + set for variability would lead to better results in irregular word reading than phonics + morphology. We recruited 352 Grade 2 and 3 struggling readers (166 males, 186 females; M_{age} = 7.67 years, SD = .68) from four school divisions in

Alberta, Canada, who received intervention in small groups (2-4 children), 4 times a week, 30 minutes each lesson, for 15 weeks. Results of hierarchical linear modeling showed that there was a significant effect of intervention from pre-test to post-test and delayed post-test with large effect sizes in all reading outcomes. There was no significant difference between the two intervention conditions in irregular word reading. These findings suggest that theory-driven intervention can have a positive impact on children's reading performance in early grades. However, about a quarter of our participants did not respond to the intervention which suggests that they would need additional and perhaps more intense intervention.

Overall, this dissertation provides important insight into the home- and school-based reading intervention practices during COVID-19. Our findings add to those of previous studies of the pandemic that examined the home literacy environment by providing preliminary evidence that home learning activities during school closures influenced at-risk children's reading skills. It also adds to a growing body of intervention research aimed to address learning losses due to COVID-19 by showing that explicit, systematic, and intensive instruction can improve the reading performance of struggling readers when intervention is delivered with a high level of fidelity.

Preface

This thesis is an original work by Kristy Dunn under the supervision of Dr. George Georgiou at the University of Alberta. Research project 1 received research ethics approval from the University of Alberta Research Ethics Board, Project Name "Contrasting the Effects of Two Teacher-Delivered Reading Interventions to Grade 1 Poor Readers", No. Pro00100353, approved April 28, 2020, funded by Alberta Education, Grant number: RPP-2019-0022. Research project 2 received research ethics approval from the University of Alberta Research Ethics Board, Project Name "Bridging the Reading Gap Caused by COVID-19: A Collaborative, Evidence-based Approach", No. Pro00111077, approved May 25, 2021, Grant number: RPP-2021-0010, funded by Alberta Education.

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Kristy Dunn was responsible for creating and developing the intervention conditions in Study 2, coordinating and training teachers, data collection and management, and writing of the dissertation. Dr. George Georgiou was the dissertation supervisor and assisted with the concept formation, data analysis, interpretation, revision, and editing.

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Chapter 1: General Introduction

In March 2020, the COVID-19 pandemic forced the shutdown of schools across the world. It has been estimated that more than 1.5 billion students in over 190 countries moved from in-person to remote learning (UNESCO, 2021). With this abrupt shift, students, parents, and educators had to quickly adjust to a new and unfamiliar mode of instruction with the uncertainty of what lies ahead.

Since then, several studies have examined the impact of COVID-19 pandemic on students' academic achievement (e.g., Chatzoglou et al., 2023; Georgiou, 2021; Förster et al., 2023; Ludewig et al., 2022; Kuhfeld et al., 2023; Molnár & Hermann, 2023). In their meta-analyses, Betthäuser et al. (2023) and König and Frey (2022) estimated the learning losses to be equivalent to roughly a one third year's worth of learning. Even though the impact of the COVID-19 pandemic on students' academic achievement is indisputable, much less is known about the impact of parent- and teacher-related efforts to mitigate the adverse effects of COVID-19 on students' learning, particularly for those children who were at-risk of reading disabilities. Thus, the overall goal of this dissertation was to address this limitation in the literature.

The current dissertation consists of two studies that aimed to provide important insights into whether different home and school interventions aided at-risk students' reading performance during the COVID-19 pandemic. The first chapter provides an overview of the general and specific impact of COVID-19 on children, along with a review of the literature on the role of home literacy environment on children's reading during the COVID-19 pandemic, and the reading interventions that were conducted. In chapter 2, we present the results of the study we completed during the first wave of COVID-19 when the schools were forced to close (March 2020 to September 2020) and examined the parent- and teacher-related factors that influenced at-

risk children's reading development. Chapter 3 focuses on a study we conducted during the 2020-2021 school year that examined the effects of two reading interventions (i.e., Phonics + Set for Variability and Phonics + Morphology) on Grade 2 and 3 struggling readers' reading performance. The final chapter concludes with a general discussion of the main findings and their implications.

The General Impact of COVID-19 on Children

The COVID-19 pandemic led to one of the largest disruptions in educational history, forcing schools to immediately close their doors and shift to remote learning. Many children had limited access to educational resources, teacher and parent support, access to technology and internet connectivity (UNESCO, 2021). While initial reviews and meta-analyses provided projections on the potential impact of COVID-19 school closures on academic growth and achievement (e.g., Hammerstein et al., 2021; Kuhfeld et al., 2020; Panagouli et al., 2021; Zierer, 2021), later research confirmed that COVID-19 had a deeper and wider impact than first predicted (e.g., Kuhfeld et al., 2023; Patrinos et al., 2023).

During the pandemic, children experienced extended social isolation from their peers and teachers. This, along with the disruption to their daily school routine, increased internalizing (e.g., anxiety, withdrawal) and externalizing behaviours (e.g., defiance, physical aggression) (Ng & Ng, 2022). Systematic reviews on the impact of COVID-19 on mental health (Ng & Ng, 2022; Panchal et al., 2023) have shown that children and adolescents significantly struggled during COVID-19, particularly those of vulnerable groups with previous mental health difficulties or with special educational needs and disabilities (e.g., Amorim et al., 2020; Waite et al., 2020). In a review of 61 studies, Panchal et al. (2023) found that anxiety followed by depression were the most commonly reported symptoms across studies (range of occurrence = 1.8 % - 49.5% and

2.2% - 63.8% of the students, respectively). Other symptoms reported included irritability (range = 16.7% – 73.2%) and anger (range = 30.0% - 51.3%). Disruptions to school routines also negatively impacted children and adolescents with special education needs, Autism Spectrum Disorder (ASD) and/or disabilities, who relied on carefully constructed school routines. As a result of the school closures, there was also a significant increase in the symptoms of Attention Deficit Hyperactivity Disorder (ADHD), for example, inattention, sleep disturbances, irritability, frustration, and social isolation (e.g., Commodari et al., 2020; Gimenez-Dasi et al., 2020).

In addition to impacting the social-emotional behavior in children, the COVID-19 pandemic also had negative effects on school achievement. Hammerstein et al. (2021) systematically reviewed 11 studies on the impact of COVID-19 school closures and found an overall negative effect on student achievement in mathematics and reading ($d = -0.10$ standard deviations [*SD*] and −0.09 *SD* for mathematics and reading, respectively). The effects were found to be more pronounced in younger students and in students from lower socioeconomic status families. In a more recent meta-analysis of 18 studies, König and Frey (2022) reported a higher overall effect size ($d = -0.17$).

The Impact of COVID-19 on Children's Reading

Several studies across the world have examined the impact of COVID-19 pandemic on children's reading performance (e.g., Clark et al., 2021; Engzell et al., 2021; Georgiou, 2021; Kuhfeld et al., 2023; Lerkkanen et al., 2023; Relyea et al., 2023; Schult et al., 2021). In a recent study covering five million Grade 3 to 8 students in the US, Kuhfeld et al. (2023) reported that the average Fall 2021 reading scores on a standardized reading measure were .09 to .17 standard deviations lower relative to same-grade scores in the Fall 2019 (before the pandemic). Simply put, compared to the growth a typical (pre-pandemic) student would make in these grades, these

score declines represent roughly a third of a school year's worth of growth. The effects were also larger for students attending high poverty schools and students of minority groups (e.g., Hispanic and Indigenous, and Black students). In addition, Lerkkanen et al. (2023) analyzed the developmental reading trajectories of a sample of Finnish Grade 3 children across Grades 1, 2, and 4 to a pre-COVID sample and found that the COVID sample had lower-level skills compared to the pre-COVID sample, and that from Grade 2 to 4 the development of reading fluency and comprehension in the COVID sample was slower. Taken together, this piece of evidence suggests that not only the overall performance during the pandemic was lower compared to pre-pandemic times, but also the growth of reading was slower.

In Alberta, Canada, Georgiou (2021) compared the performance of Grade 2 to 9 children in September 2020 (when the schools reopened) to that of children in the same schools in the three years prior to the pandemic. Results showed that only Grades 2 and 3 were impacted with performance being 6-8 months behind grade level. Children in Grades 4 to 9 either maintained their performance or improved during the school closures. Unfortunately, Georgiou (2021) did not examine if the effects were moderated by different variables (e.g., ethnicity, school location, children's reading status).

Research has shown that the effects of COVID-19 on students' reading performance were moderated by different factors (e.g., Bol, 2020; Chatzoudi et al., 2023; Darmody et al., 2021; Kuhfeld et al., 2023; Pensiero et al., 2020; Schuurman et al., 2023). For example, children who were in the early stages of reading development were more vulnerable to significant losses due to reduced access to intensive instruction (e.g., Bao et al., 2020; Georgiou, 2021; Tomasik et al., 2021; Wyse et al., 2020; see also König & Frey's, 2022, meta-analysis).

Another important moderator was family's socioeconomic status (e.g., Donnelly & Patrinos, 2022; Kuhfeld et al., 2023; Maldonado & De Witte, 2020). Even though socioeconomic status was operationalized differently in different studies (e.g., through parents' education, through school's location), findings suggest that students from lower-SES families were impacted more than students from higher-SES families (e.g., Gore et al., 2021; Pensiero et al., 2021; Schuurman et al., 2023). For example, using the national achievement data of approximately 350,000 Dutch primary school students, Engzell et al. (2021) found an average learning loss of -0.08 SD or one-fifth of a school year. This loss was up to 60% larger for the children from lower SES homes. Blundell et al. (2020) suggested that parents in higher-income families, and with higher levels of education, were better able to cope and support their children with remote learning compared to parents of children in low-income families.

The COVID-19 pandemic also had negative effects on English Language Learners (ELLs) and students with reading disabilities (e.g., Fuchs et al., 2023; Reylea et al., 2023). ELLs often come from low-income immigrant families and under-resourced communities that have limited access to rich learning opportunities (Relyea et al., 2023). According to Sugarman and Lazarin (2020), the transition to remote learning during COVID-19 school closures isolated many ELLs in home situations where English was not spoken as the primary language. As a result, many children lacked the chance to develop their English language and reading skills. Online resources and supports were reported as insufficient to meet their specific needs and parents were limited in their capacity to support English learning at home due to their own lack in English proficiency. For example, in a US study that examined the reading achievement of Grade 3–5 ELL students during COVID-19 school closures relative to pre-COVID-19, Reylea et al. (2023) found that the learning loss effect size for these students ranged from -0.28 to -0.54;

these values are much higher than the average effect size reported in Hammerstein et al.'s (2021) and König and Frey's (2022) meta-analyses.

In contrast to ELL students, the findings for students with reading disabilities are less clear (e.g., Chatzoudi et al., 2023; Fuchs et al., 2023; Kim & Fienup, 2021; Petretto et al., 2020). Although Fuchs et al. (2023) showed that the effects of COVID-19 pandemic on children with reading difficulties were larger than for typically-developing controls, Chatzoglou et al. (2023) found that effects were larger in a sample of typically-developing Grade 4 and 8 children (n = 219, 500). Moreover, results of gap analysis indicated that the change in average pre-pandemic (2019) to post-pandemic (2022) reading scores between the groups of the Grade 4 and Grade 8 children was 2.71 years and 2.38 years, respectively.

Home Literacy Environment and Children's Reading During Covid-19

Because schools closed down during the first COVID-19 wave (Spring 2020), much of the instruction routines shifted from teachers to parents. Thus, exploring the role of home literacy environment (HLE), an umbrella term used to encapsulate the experiences, attitudes and materials related to literacy that a child encounters and interacts with at home (Burgess et al., 2002), is important. Did parent's teaching during the first COVID-19 have a positive influence on their children's reading performance? In this dissertation, we tried to answer this question by focusing on a group of children who were at-risk for reading difficulties and for whom small group pullout reading intervention at school was no longer available.

Home literacy activities are typically grouped into two categories (code-based and meaning-based; sometimes they are also referred in the literature as "formal" and "informal"; Sénéchal, 2006; Sénéchal & LeFevre, 2002) and each of these categories influence reading through a different path. According to the HLE model (Sénéchal & LeFevre, 2002), code-based HLE activities influence reading through the effects of letter knowledge. In turn, meaning-based

HLE activities influence reading through the effects of vocabulary. Studies conducted in different languages have generally confirmed these associations (e.g., Inoue et al., 2018, 2020; Liu et al., 2018; Sénéchal, 2006).

A few studies have looked at HLE during COVID-19, particularly during the Spring 2020 when schools closed down (e.g., Aram et al., 2022; Karabanov et al., 2022; Lin et al., 2023; López-Escribano et al., 2021; Sonnenschein et al., 2021; Sun et al., 2021, 2023; Wheeler & Hill, 2021). These studies compared the frequency of different HLE activities during COVID-19 to that before COVID-19. Their findings were mixed. On the one hand, some studies have shown that the frequency of parent-child shared book reading during COVID-19 increased compared to pre-COVID-19 (e.g., Aram et al., 2022; Sonnenschein et al., 2021; Wheeler & Hill, 2021). For example, working with a group of Grade 1 Israeli children, Aram et al. (2022) found that parent-child shared book reading before COVID-19 was quite frequent, yet during the pandemic lockdown, parents read even more frequently to their children. Survey studies with US preschooler samples also showed an increase in screen-based reading practices (Read et al., 2021; Sun et al., 2023). On the other hand, other studies have reported a decrease in home book reading, storytelling, and writing activities during COVID-19 (e.g., Borges et al., 2023; Lin et al., 2023).

Even though studies examining the frequency of different HLE activities during COVID-19 are important, it remains unclear if the different HLE aspects during COVID-19 were actually related to children's reading skills. To our knowledge, only two studies examined the relation of HLE during COVID-19 with children's reading-related skills (Kartushina et al., 2022; Sun et al., 2023). Surveying 1742 parents of toddler-age children across 15 countries, Kartushina et al. (2022) found that children's vocabulary size over the first 1 to 2 months of lockdown increased at a faster speed than the age norm, and importantly, their vocabulary growth was positively

associated with parents' shared reading time during COVID-19, controlling for demographics such as socioeconomic status. In turn, Sun et al. (2023) followed a sample of 237 school-age children (142 of them were bilingual and 95 monolingual) from May to October 2019 (before COVID-19) to December 2020 to July 2021 (during COVID-19) and examined if three HLE variables (i.e., number of books at home, parents' weekly bedtime reading frequency during COVID-19, and children's weekly independent reading time during COVID-19) were predictive of children's reading comprehension during COVID-19, after controlling for children's bilingual status, family's socioeconomic status and children's earlier reading comprehension. Results showed that only child's independent reading time during COVID-19 was a significant predictor. Even though these two studies indicate that some HLE aspects may be related to children's language and literacy development, they have some important limitations. First, the study by Kartushina et al. (2022) focused on toddler-age children over a short period of time (41 days between tests on average) and we do not know if their findings generalize to older children and their reading development. Second, because Sun et al. (2023) was primarily interested in bilingual children's reading growth, their sample included more bilingual children, whose reading development and parental involvement may differ from those of monolingual children (Paradis & Jia, 2017). Finally, none of these studies examined the role of HLE aspects on at-risk children's reading performance.

Reading Interventions During the COVID-19 Pandemic

It has been well established that early reading intervention through systematic, small group intensive instruction can effectively improve reading performance (see Gersten et al., 2020; Hall et al., 2022; Wanzek et al., 2016), for systematic reviews and meta-analyses). Given the documented impact of COVID-19 on students' reading performance (Kuhfeld et al., 2023,

2020), particularly for those who were struggling to read before the COVID-19 outbreak (Baschenis et al., 2021), the delivery of immediate intervention became crucial. In the U.S., the Office of Special Education Programs (2020) called on special educators to provide all students, including students without disabilities, immediate intervention in order to reduce the impact of COVID-19 pandemic on students' academic achievement. In Canada, most provinces announced special funding for reading intervention. For example, Alberta Education offered $45 million emergency funding for schools to provide reading and math intervention in early grades and school divisions were asked to report on the progress of the children receiving intervention (Joannou, 2021). Thus, a key goal of this dissertation was to examine the effects of a reading intervention on at-risk Grade 2 and 3 students returning to in-person learning after the COVID-19 school closures.

To the best of our knowledge, only a handful of reading interventions have been conducted during the COVID-19 pandemic (Beach et al., 2021; Cadime et al., 2022; Cancer et al., 2021; Cruz et al., 2022; Fuchs et al., 2023; Sucena et al., 2022; Sun et al., 2023; Tsesmeli & Skarmoutsou, 2023) and vary in their instructional focus, session duration, and method of delivery. A group of intervention studies aimed to address the learning needs of all students (e.g., Cruz et al., 2022; Sucena et al., 2022). For example, Cruz et al. (2023) examined the effects of a reading fluency intervention in a sample 207 Grade 3 students who were randomly assigned to two experimental groups (remote versus face-to-face) and a control group. The intervention lasted 20 sessions (2 sessions per week, 50 minutes each) and was delivered in small groups of 2–4 children. Results showed gains in both intervention groups compared to the control group in reading accuracy, text reading accuracy, and text reading fluency. The effects were also similar for the face-to-face and remote delivery. Sucena et al. (2022) also reported significant

improvements in different reading-related skills (letter-sound knowledge, phonemic awareness, decoding, and spelling) in a 5-week online intervention with a sample of 446 Grade 2 students. Their intervention consisted of ten activities that trained phonemic awareness and phonics, as well as the processes of spelling and decoding. Unfortunately, this study did not include a control group and, like Cruz et al. (2023), did not measure treatment fidelity. The authors noted this as a limitation but stated that due to the urgency of the pandemic they did not select any children for a non-intervention condition.

A few of the intervention studies focused on providing intervention to students screened for reading difficulties (e.g., Cadime et al., 2022; Cancer et al., 2021; Fuchs et al., 2023). Cancer et al. (2021), for example, examined the effectiveness of a rhythm-based tutor-delivered intervention (10–45 min sessions on syllabic blending/reading, word/sub-lexical decoding) in a selected sample of 30 children (ages 8-13) with dyslexia who were randomly assigned into a remote (n = 15) and an in-person (n = 15) group. Results showed a significant improvement in reading in both groups with small effect sizes on speed and accuracy, and no significant differences between the delivery modes. Cadime et al. (2022) also examined the effects of small group reading intervention in a sample of 81 Grade 2 children at-risk of reading disabilities. The intervention included 27 sessions (twice a week, 40-minutes each time) delivered face-to-face outside of the classroom (November 2020) and then moved to a remote format from mid-January to mid-March 2021 due to lockdown. Results showed significant improvements in all outcome variables (word reading, oral reading fluency, listening comprehension) with the largest effect for oral reading fluency.

Even though all reading intervention studies reported significant improvements in reading, they had some important limitations. Of the eight intervention studies, only two

included a control group (Fuchs et al., 2023; Tsesmeli & Skarmoutsou, 2023), only two measured treatment fidelity (Beach et al., 2021; Fuchs et al., 2023), and no studies included a delayed post-test. Reporting on treatment fidelity is critical because as Dahl-Leonard et al. (2023) showed treatment fidelity increases the internal validity of a study by evaluating the intervention's effects. In addition, including a delayed post-test is important to examine if the effects of these interventions remained over time.

The Current Dissertation

The current dissertation consisted of two studies in which different aspects of early reading intervention were examined in the home literacy and school environment during the COVID-19 pandemic. The first study examined whether different parent- and teacher-related factors influenced at-risk Grade 1 children's reading performance during the first six months of the COVID-19 after the schools closed. In April 2020, one month after school closures, we invited the parents and teachers of the participants to fill out a questionnaire. Parents reported on their educational level, how often they engaged with their child in different home learning activities (e.g., teaching their child to read words, reading a story to their child), how much their child enjoyed reading, and how many children's books they had at home. Teachers were asked to report on their perceived ability in teaching struggling readers, the frequency of providing reading instruction online and worksheets focusing on reading, whether they differentiated instruction, and how challenging they found online teaching of reading. Briefly, results showed that children's reading enjoyment and home learning activities predicted both word and pseudoword reading development, and differentiation of instruction predicted pseudoword reading development.

In the second study, we aimed to improve the reading performance of struggling readers

returning in September 2020 immediately after schools reopened. Specifically, we examined the effects of two reading interventions (phonics + set for variability and phonics + morphology) on students' reading performance. Briefly, results showed that there was a significant effect of intervention from pre-test to post-test and delayed post-test with large effect sizes in all reading outcomes. There was no significant difference between the two intervention conditions. These findings suggest that early interventions can have a positive impact on children's reading performance even when delivered during a pandemic. However, about a quarter of our participants did not respond to the intervention which suggests that they would perhaps need a different or more intensive intervention.

Overall, this dissertation aimed to address the current gap in the research on reading intervention during COVID-19. Study 1 added to the previous studies that examined HLE and reinforced the importance of the role of parents in their children's early reading development. In Study 2, the findings suggested that a small group intervention with strong fidelity can have a positive impact on improving children's reading performance. Taken together, these studies show that home- and school-based interventions during the COVID-19 pandemic were important for promoting the reading performance of struggling readers.

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Chapter 2: Home and School Interventions Aided At-risk Students' Literacy During COVID-19: A Longitudinal Study

Introduction

In March 2020, schools in Alberta (Canada) as well as in many other places around the world closed because of the COVID-19 pandemic. The decision to close schools meant that teaching transitioned to an online environment, teachers had to become comfortable teaching through a computer, and children had to get used to spending a considerable amount of time in front of a monitor. This decision also meant that children at risk for reading difficulties no longer received their typical face-to-face, small group, pull out intervention, and any additional support was henceforth provided online by the classroom teacher with the help of parents. Despite evidence showing that parents engaged more frequently in different home learning activities with their children during the pandemic than before (e.g., Aram et al., 2022; Sonnenschein et al., 2021; Wheeler & Hill, 2021), it remains unclear if their more frequent involvement had an impact on their at-risk children's reading development. Thus, in this study we examined whether different parental (i.e., frequency of home learning activities, access to literacy resources, and parent-rated children's reading enjoyment) and teacher-related (i.e., perceived ability in teaching struggling readers, frequency of teaching reading online, frequency of providing instructional materials, differentiation of instruction for struggling readers, and difficulty teaching reading online) factors had an effect on at-risk children's reading development during the school closures. To our knowledge, this is the first attempt to link parental and teacher instruction during the pandemic to children's reading outcomes.

Home Literacy Environment and Children's Reading Performance

The effects of parents on their children's reading performance have typically been captured by home literacy environment (HLE). HLE refers to the experiences, attitudes and

materials related to literacy that a child encounters and interacts with at home (Burgess et al., 2002; Roberts et al., 2005). According to the most popular HLE theoretical account, the home literacy model (Sénéchal & LeFevre, 2002; see also Sénéchal et al., 2017, for a review), the home literacy experiences can be grouped into two broad categories: the code-related, or "formal", home literacy experiences that engage children directly with print through activities such as teaching of letters and words, and the meaning-related, or "informal", home literacy experiences that expose children to print incidentally through activities such as shared book reading. Studies conducted in different countries have shown that the code- and meaning related HLE experiences predict word reading indirectly through their effect on emergent literacy skills. More specifically, code-related HLE has been found to predict word reading through its effects on letter knowledge and phonological awareness, and meaning-related HLE has been found to predict word reading through its effects on vocabulary (e.g., Frijters et al., 2000; Hamilton et al., 2016; Lehrl et al., 2020; Manolitsis et al., 2013; Sénéchal, 2006; Torppa et al., 2022; Zhang et al., 2020).

More recently, researchers have argued that the HLE model needs to expand to also include "access to literacy resources" (ALR; most often operationalized with the number of children's books at home) and children's interest in reading (see Georgiou et al., 2021; van Bergen et al., 2016; Vasilyeva et al., 2018; Wang & Liu, 2021; Zhang et al., 2020 see also Martini & Sénéchal, 2012). It is important to have age-appropriate literacy materials at home as they are significant tools for facilitating children's engagement in literacy activities and parent-child interactions. Importantly, whenever ALR is included in the same model with code- and meaning-related activities, the effects of meaning-related activities on vocabulary and/or word reading becomes non-significant (e.g., Inoue et al., 2020; Wang & Liu, 2021; Zhang et al., 2020).

Similar to ALR, children who are interested in learning to read/spell words or enjoy reading will likely request literacy activities more often and also participate in them more deeply. Previous studies that examined the role of reading interest/enjoyment in children's reading performance have provided mixed findings. Whereas some studies have shown that literacy interest was predictive of emergent literacy skills (e.g., Baroody & Diamond, 2012; Martini & Sénéchal, 2012), other studies have reported no significant relations (e.g., Calgar-Ryeng et al., 2020; Roberts et al., 2005; Silinskas et al., 2020).

It should be noted here that most of the aforementioned HLE studies have been conducted with typically-developing children transitioning from preschool/kindergarten to primary school (see Sénéchal et al., 2017, for a review). A natural follow-up question would be if similar relations could be observed in children at-risk for reading difficulties. This is important for several reasons: First, what we know regarding the role of HLE in reading in typically-developing children may not generalize to at-risk children. In fact, preliminary evidence from studies that included at-risk or struggling readers show some important differences (see below for details). Clearly, the findings of these studies need to be replicated. Second, there is evidence from longitudinal studies that parents adjust their teaching in response to their children's reading performance (e.g., Inoue et al., 2018; Manolitsis et al., 2011; Silinskas et al., 2012). Given that the parents of the children in our sample had been informed that their child was experiencing reading difficulties and they had consented for their child to receive pull out reading intervention (even though this never happened because the schools closed), this may have provoked more parental involvement in their children's learning at home. However, according to the family risk model (Snowling et al., 2007), parents of low-literate children often have low literacy skills themselves and may be unable to help if schools are closed. Finally, reports from parent surveys during the pandemic have revealed that parents were particularly concerned for the academic

growth of children with learning difficulties because they did not feel well equipped to replace the expert teachers in providing instruction to their children (e.g., Garbe et al., 2020; Sonnenschein et al., 2022; Thorell et al., 2021). Because much of the teaching of these children fell on parents' shoulders when the schools closed, examining the role of different parental factors (e.g., frequency of home learning activities, access to literacy resources) in at-risk children's reading performance is important.

The studies that have examined the HLE-reading relationship in at risk/struggling readers can be grouped into two categories: those that compared children with or without a risk for reading difficulties in different HLE aspects (e.g., Kirby & Hogan 2008; Zhang et al., 2019) and those that examined the relations of different HLE aspects with children's reading in different reading ability groups (e.g., Baroody & Diamond, 2012; Inoue et al., 2018; Silinskas et al., 2013; see also Hamilton et al., 2016; Torppa et al., 2022, for studies with children at familial risk of dyslexia). In regard to the former category, Kirby and Hogan (2008) compared a group of poor and good Grade 1 readers in Canada on a number of HLE aspects and found that children who were good readers were read to by adults and were taught printed letters, letter sounds, and words more frequently than children who were poor readers. Parents of children who were good readers also reported a greater total number of books at home. In addition, results of discriminant function analyses indicated that the combination of family environment and SES variables (mother's and father's education) could successfully classify over 88% of the children in the good and poor readers' groups, respectively.

In regard to the latter category, Silinskas et al. (2013) performed a longitudinal study in which they followed 1460 mother-child dyads in Finland from the beginning of Grade 1 to the end of Grade 1. The results of regression mixture modeling identified four latent subgroups of children in which the frequency of maternal teaching showed a differential contribution to

children's subsequent reading skills: Among 14% of the children with low reading skills at the beginning of Grade 1, maternal teaching was positively associated with children's reading skills at the end of Grade 1 (β = 0.34); among 22% of the children who showed relatively low reading skills, maternal teaching had no association with children's reading skills (β = −0.04, ns); among 12% of the children who were good readers, maternal teaching had no association with children's reading skills (β = −0.19, ns); and among the remaining 52%, maternal teaching had a negative association with children's reading skills (β = −0.23). In a study with Japanese children followed from the Grade 1 to Grade 2, Inoue et al. (2018) also showed no effects of either parents' teaching or shared book reading in Grade 1 on children's reading performance in Grade 2 in the group of poor readers. Assuming the findings of these studies with struggling readers will generalize to the COVID-19 pandemic era, we should not observe any significant effects of parents teaching on their at-risk children's reading performance in our study. Unfortunately, Silinskas et al.'s study assessed only the frequency of mother's teaching and neither Silinskas et al. nor Inoue et al. measured children's reading enjoyment. In our study, we assessed parents' teaching and access to literacy resources as well as children's reading enjoyment.

Teacher-related Factors and Children's Reading Performance

According to the ecological systems theory (Bronfenbrenner, 1979), teachers also play a key role in children's development and their effect is independent of that exerted by parents. For the purpose of this study, we examined the role of four teacher-related factors in at-risk children's reading development: their self-rated ability in teaching struggling readers (i.e., self-efficacy), the frequency of providing online reading instruction and different reading-related materials, whether they differentiated instruction for struggling readers, and how challenging they found providing reading instruction online.

Teachers' self-efficacy, defined as the extent to which a teacher is confident about his/her ability to promote students' learning (Bandura, 1994), can be a significant driver of children's academic growth. Teachers with high levels of self-efficacy tend to have high levels of planning and organization skills and adjust strategies and pedagogy to the level of their students. These teachers also set and hold higher expectations for their students and themselves and make it a priority to assist students who need extra help (e.g., Ashton & Webb 1986; Tschannen-Moran & Barr, 2004; Tschannen-Moran & McMaster, 2009). Given that our sample comprised struggling readers, teachers' self-efficacy in teaching these children should be a significant predictor of their reading development.

Equally important for struggling readers during the COVID-19 pandemic should be teachers' ability to adapt their instruction to meet their students' learning needs. The argument put forward to support differentiation of instruction is that it contributes to student learning (e.g., Connor et al., 2009, 2013; Juel & Minden-Cupp, 2000). Effective literacy instruction in early grades in English includes explicit and systematic instruction of letter knowledge, phonemic awareness, and the relationship between graphemes and phonemes (e.g., Connor et al., 2004; de Graaff et al., 2009; Savage et al., 2020). Kiuru et al. (2015) and Ruotsalainen et al. (2022) provided evidence that Grade 1 teachers are sensitive to their students' reading performance and adapt their instructional practices accordingly. Given that the teachers who participated in our study received professional development on how to differentiate instruction and they were given access to materials targeting phonemic awareness and phonics (the skills that most Grade 1 poor readers struggle with), we would expect teachers who differentiated their instruction to have a positive impact on their students' reading performance.

Because during the first wave of Covid-19 teachers were given the freedom of choosing the best way of providing reading instruction to their students, this led to a situation where some

teachers would meet online every day with their students whereas others would only meet once a week and substituted the additional instructional time with different reading materials that students were supposed to complete on their own or with the help of their parents. It remains unclear if the frequency of engaging in online teaching or providing reading materials to their students would predict their students' reading outcomes. Finally, teachers have a different level of comfort with technology (Dogan et al., 2021; Leech et al., 2020). During the school closures teachers had to shift quickly to online teaching with the help of different programmes (e.g., Google Meets, Microsoft Teams) and to become familiar with their many features within a very short period of time. We expected that the teachers who felt more comfortable teaching reading online would have a more positive effect on their students' reading development.

The Present Study

The purpose of this study was to examine whether different parent and teacher-related factors contributed to at-risk children's reading development during the Covid-19 pandemic. We asked the following two questions:

1) Did frequency of parent teaching of reading, access to literacy resources, and children's reading enjoyment (as rated by their parents) influence at-risk children's reading development during COVID-19 pandemic?
2) Did teachers' self-rated ability in teaching struggling readers, the frequency they provided online reading instruction and reading materials, whether they reported differentiating instruction for struggling readers, and how challenging they found teaching reading online influence at-risk children's reading development during COVID-19 pandemic?

Importantly, we examined the role of different factors before and after controlling for children's reading performance at an earlier point in time (i.e., the autoregressor). Given that

reading ability is relatively stable during the early grades (e.g., Landerl et al., 2019; Leppänen et al., 2006), controlling for children's earlier reading ability provides a conservative test of parents' and teachers' contributions to children's reading performance.

Method

Participants

The participants in this study were 70 Grade 1 children (28 females, 42 males; M_{age} = 6.60, *SD* = 0.46) who were at-risk for reading difficulties as well as their parents (*n* = 70) and teachers (*n* = 40). The children were participating in a larger study examining the role of early intervention in children's reading performance (Georgiou, 2019) and they were deemed to be at-risk for reading difficulties if their scores in the Wide Range Achievement Test-5 (WRAT-5) Word Reading (Wilkinson & Robertson, 2017) and Comprehensive Test of Phonological Processing-2 (CTOPP-2) Phoneme Deletion (Wagner et al., 2013) tasks were below the 25th percentile, and their nonverbal IQ was above 80.[1] The children were recruited from 40 Grade 1 classes at 26 public schools in Edmonton, Canada and they were assessed twice: in February 2020 (before the school closures; Time 1) and in September 2020 (when they returned back to school; Time 2). 92% of the children were White, 4% East Asian, 3% First Nations, Metis or Inuit, and 1% Other. The children had normal or corrected-to-normal vision, average nonverbal IQ (*M* index score = 97.04; *SD* = 11.49) and no sensory or behavioural difficulties (based on teachers' reports). In April 2020 (a month after the school closures in Edmonton), we invited the parents and teachers of the participating children to fill out a questionnaire via Qualtrics. Parents were asked to report on their educational level, how often they engaged with their child in

[1] We measured nonverbal IQ because intellectual ability is part of the fourth criterion in DSM-5 for the identification of children with reading difficulties and many reading intervention studies include it to show that the experimental and control groups did not differ in nonverbal IQ (see e.g., Lovett et al. 2017; Velluntino et al. 2008). However, we acknowledge that groups with different nonverbal IQ scores may respond similarly to reading intervention (Fletcher et al., 2019; Morris et al., 2010).

different home learning activities (e.g., teaching their child to read words, reading a story to their child), how much their child enjoyed reading alone, and how many children's books they had at home. The questionnaire was filled out by 64 mothers (91.4% of our sample). Parents of six children (8.6% of our sample) reported filling out the questionnaire together. Teachers were asked to report on their perceived ability in teaching struggling readers, the frequency of providing reading instruction online and worksheets focusing on reading, whether they differentiated instruction, and how challenging they found online teaching of reading. Ethics permission for this study was obtained from the research ethics board of the University of Alberta (Pro00100353). In addition, written consent was obtained from both parents and teachers.

Materials

Child Measures

Children were administered two reading measures (WRAT-5 Word Reading and WIAT-3 Pseudoword Decoding) at both times and measures of nonverbal IQ and phonological awareness at Time 1.

Nonverbal IQ. The Simultaneous Matrices from the Cognitive Assessment System-2 Brief (Naglieri et al., 2014) was administered to assess nonverbal IQ. Children were asked to select one of six options that best completes a matrix with a missing piece. The task was discontinued after four consecutive errors and a participant's score was the total number of correctly answered items (max = 44). The raw score was subsequently converted to an index score following the instructions in the manual. Cronbach's alpha reliability in our sample was 0.94.

Phonological Awareness. The Phoneme Deletion task from CTOPP-2 (Wagner et al., 2013) was administered to assess phonological awareness. Children were asked to say a word

and then say the word without one of its sounds (e.g., Say “cup”. Now say “cup” without saying /k/). The task was discontinued after three consecutive errors and a participant’s score was the total number correct (max = 33). The raw score was subsequently converted to a scaled score with a mean of 10 and a standard deviation of 3. Cronbach’s alpha reliability in our sample was 0.90.

Word Reading. In Word Reading from WRAT-5 (blue form; Wilkinson & Robertson, 2017), children were asked to first name 15 letters and then read aloud individual words from a list of 55 lowercase words arranged in increasing difficulty. The task was discontinued after six consecutive errors and a participant’s score was the total number of words read correctly (max = 70). Cronbach’s alpha reliability in our sample was 0.96 at both measurement points. In WIAT-3 Pseudoword Decoding (Wechsler, 2009), children were asked to name aloud a list of 52 pronounceable pseudowords. The task was discontinued after six consecutive errors and a participant’s score was the total number of pseudowords read correctly (max = 52). Cronbach’s alpha reliability in our sample was 0.92 at Time 1 and 0.94 at Time 2. In both reading tasks, we converted the raw scores into standard scores following the instructions in the manuals.

Parent Questionnaire

Parent Measures. Parents were asked to fill out a questionnaire with four questions. First, we asked parents to report on their highest achieved education. There were nine options ranging from “completed elementary school” to “completed graduate studies”. The score for parents’ education was calculated by averaging the z scores for mother’s and father’s education. The correlation between mother’s and father’s education was 0.46 in our sample. Second, we asked parents to indicate on a Likert scale ranging from 0 (none) to 4 (more than 150 books) how many children’s books they had at home. Third, we asked parents to indicate on a Likert scale ranging from 0 (never) to 4 (daily) how often in the previous week their child read alone for

enjoyment (i.e., not as part of his/her homework). Finally, we asked parents to think of their last week and indicate how much time they spent daily on home learning activities related to reading (e.g., teaching their child to read words, read a story to their child) with their children. We gave them five options: 1–2 h (0), 2–3 h (1), 3–4 h (2), 4–5 h (3), and more than 5 h (4). These questions have been sampled from previous HLE studies (e.g., Kirby & Hogan 2008; Sénéchal, 2006) and are similar to questions included in other HLE questionnaires used during the pandemic (e.g., King et al., 2020; López-Escribano et al., 2021).

Teacher Questionnaire

Teachers were asked to fill out a questionnaire with six questions. First, we asked teachers to rate their ability to teach struggling readers. The Likert scale had four options (minimal, moderate, good, expert). Second, we asked them to indicate using a Likert scale the frequency of providing their students online reading instruction. They were given five options ranging from 0 (never) to 4 (daily). Third, we asked teachers to indicate using a Likert scale the frequency of providing their students worksheets focusing on reading. They were given five options ranging from 0 (never) to 4 (daily). Fourth, we asked them to indicate by choosing Yes or No if they differentiated reading instruction for their struggling readers. Finally, we asked them to indicate on a scale from 0 to 10 (10 being very easy) how challenging they found providing reading instruction online.

Procedure

To examine the effects of both child-level and teacher-level variables on children's later reading outcomes, we performed multilevel regression analyses (Heck & Thomas, 2009). Children's scores on the two reading tests at Time 2 were used as the dependent variables. For the child-level predictors, we used parents' education, number of books in the home, reading enjoyment, and home learning activities. For the teacher-level predictors, we used their

perceived ability of teaching, the frequency of providing online reading instruction and worksheets, differentiation of instruction, and how challenging they found providing online instruction. We ran the analyses twice: with and without controlling for the effects of reading ability at Time 1 (i.e., the autoregressor).

All multilevel analyses were performed using Mplus (Version 8; Muthén & Muthén, 1998–2017) with the TYPE=TWOLEVEL function. Given the relatively small sample sizes at both within- and between-levels (we had 40 teachers in our sample, and the number of children in each class ranged from one to six [M = 1.75, SD =1.08]), we used the Bayesian estimation, which was expected to be more precise at small sample sizes (Hox & McNeish, 2020), with Markov chain Monte Carlo algorithms. Each of the models was run for 10,000 iterations across three parallel chains.

Results

Preliminary Analysis

Table 1 shows the descriptive statistics for all measures used in the study. The results of paired t-tests showed that the raw score improvements in our sample were statistically significant in both WRAT word reading and WIAT pseudoword decoding (WRAT: t = 7.27, df = 69, p < .001, d = 0.87; WIAT; t = 5.12, df = 69, p < .001, d = 0.61), whereas the standard scores were not significantly different between Times 1 and 2 (WRAT: t=1.01, df=69, p=.32, d=0.12; WIAT: t=0.28, df=69, p=.78, d=0.03). This indicates that the children did not fall further behind in their reading skills after the school closures compared to the norming samples. Intraclass correlations (ICCs) of children's word reading skills indicated that 4% and 9% of the total variances in WRAT Standard Scores were due to classroom differences at Times 1 and 2, respectively; 14% and 36% of the total variances in WIAT standard scores were due to classroom differences at Times 1 and 2, respectively. The results further showed that the mode of teachers' perceived

ability of teaching struggling readers was ‘moderate’ (60.0%), followed by ‘good’ (37.5%). The modes of providing online reading instruction and worksheets on reading were both ‘never’ (37.5% and 30.0%, respectively), followed by ‘less than one day a week’ (22.5%) for online instruction and ‘daily’ (25.0%) for worksheets. Finally, more than half of the teachers (65.0%) differentiated their instruction for struggling readers. All variables were standardized before further analyses to ease the interpretation of coefficient estimates.

Table 1.1

Descriptive Statistics for the Child-level and Teacher-level Variables

	n	Mean	*SD*	Range	ICC
Child-level variables					
WRAT (RS)_T1	70	16.69	3.17	6–23	.00
WRAT (SS)_T1	70	81.09	7.44	58–90	.04
WRAT (RS)_T2	70	21.27	6.56	6–43	.08
WRAT (SS)_T2	70	82.43	13.44	55–126	.09
WIAT (RS)_T1	70	2.44	2.68	0–10	.26
WIAT (SS)_T1	70	83.89	9.70	66–103	.14
WIAT (RS)_T2	70	6.07	7.12	0–25	.29
WIAT (SS)_T2	70	84.24	12.73	66–117	.36
Nonverbal IQ (Index score)	70	97.04	11.49	80-130	–
Elision (Scaled Score)	70	7.23	1.78	1–9	–
Mother’s education[a]	70	3.91	2.17	0–8	–
Father’s education[a]	68	3.65	2.28	0–8	–
Number of books	70	3.44	0.94	1–4	–
Reading enjoyment	70	1.86	1.17	0–4	–
Home learning activities	70	0.63	0.78	0–3	–
Teacher-level variables					
Perceived ability of teaching	40	2.42	0.55	2–4	–
Providing online reading instruction	37	1.73	1.59	0–4	–
Providing worksheets on reading	37	2.05	1.61	0–4	–
Differentiation of instruction	37	0.70	0.46	0–1	–
How challenging they found	35	3.54	2.76	0–10	–

Note. [a.] Parents’ education included nine levels: 0 = completed elementary school, 1= some high school studies, 2= completed high school, 3= some community college studies, 4 = completed community college, 5 = some university studies, 6 = completed university studies, 7 = some graduate or professional studies, and 8 = completed graduate or professional degree. ICC = intraclass correlation. When the number of responses is less than 70 (for child-level variables) and less than 40 (for teacher-level variables), it means that some participants did not respond to that specific task/question.

Table 2 shows the correlations among the variables in the study. At the child-level, parents' education correlated with WRAT word reading at Times 1 and 2. Reading enjoyment and home learning activities also correlated with children's reading outcomes at Time 2. These results indicate that the more children enjoyed reading alone and the more engaged they were in home learning activities during the school closures, the higher their Time 2 reading outcomes. At the teacher-level, how challenging they found providing online instruction was positively associated with WRAT word reading at Times 1 and 2, indicating that the lower the children's word reading, the more challenging the teachers found it to teach reading online.

Table 2.1

Child-level (below the diagonal) and Teacher-level (above the diagonal) Correlations among the Observed Variables

	1.	2.	3.	4.	5.	6.	7.	8.	9.	10.	11.	12.	13.
1. WRAT_T1[a]		.72**	.32*	.53**	.39*	-.32*	.32*	.24	.08	-.05	-.03	.01	.47**
2. WRAT_T2[a]	.58**		.43*	.82**	.31	-.30	.56**	.41*	-.01	-.11	-.07	.18	.34*
3. WIAT_T1[a]	.41**	.38**		.54**	.04	.08	.24	.20	.22	-.32*	.23	-.10	.04
4. WIAT_T2[a]	.46**	.83**	.58**		.12	-.26	.56**	.40*	.01	-.25	.00	.22	.12
5. Parents' education[a]	.35**	.28*	-.10	.10		-.15	.18	.01	-.15	.00	-.27	-.03	.08
6. Number of books[a]	.00	-.17	.02	-.18	.11		-.27	.13	.21	.10	.03	.11	-.02
7. Reading enjoyment[a]	.11	.44**	.21	.46**	.13	-.43**		.21	-.12	-.13	-.13	-.04	-.12
8. Home learning activities[a]	.16	.31*	.14	.31*	-.02	-.03	.16		.09	.00	-.13	.06	.31
9. Perceived ability of teaching[b]	–	–	–	–	–	–	–	–		-.40*	.28	-.03	.28
10. Providing online instruction[b]	–	–	–	–	–	–	–	–	–		-.24	.23	.15
11. Providing worksheets[b]	–	–	–	–	–	–	–	–	–	–		-.31	-.02
12. Differentiation of instruction[b]	–	–	–	–	–	–	–	–	–	–	–		.32*
13. How challenging they found[b]	–	–	–	–	–	–	–	–	–	–	–	–	

Note. [a] Child-level variables. [b] Teacher-level variables. (–) Not estimated. T1 = Time 1; T2 = Time 2.
*$p < .05$; **$p < .01$.

Multilevel Regression Analysis

Table 3 shows the results of the multilevel regression analysis. In the model without the autoregressor (top half of Table 3), reading enjoyment and home learning activities during school closures predicted both WRAT word reading and WIAT pseudoword decoding at Time 2. On the other hand, no teacher-level variables during the school closures predicted children's reading outcomes at Time 2. However, it should be noted that the effect of teachers' differentiation of instruction on WIAT pseudoword decoding approached significance. Similarly, in the models with the autoregressor (bottom half of Table 3), reading enjoyment during the school closures predicted WRAT word reading at Time 2 even after controlling for WRAT word reading at Time (1) Additionally, home learning activities during the school closures predicted both WRAT word reading and WIAT pseudoword decoding at Time (2) Finally, teachers' differentiation of instruction had a significant effect on WIAT pseudoword decoding at Time 2 when WIAT pseudoword decoding at Time 1 was taken into account. This result suggests that teachers who differentiated their instruction for their struggling readers had a relatively stronger impact on their decoding skill development. Indeed, WIAT pseudoword decoding at Time 2 was significantly higher among children whose teachers differentiated instruction (M = 86.55, SD = 11.19) than those who did not (M = 80.62, SD = 8.09; Welch's t = -2.46, df = 61.77, p=.017, Hedges' g = 0.58).

Table 3.1

Results of Multilevel Regression Models

	Word Reading			Pseudoword Decoding		
		95% CI			95% CI	
	Est	LL	UL	Est	LL	UL
Model 1: Without autoregressor						
Child variables						
Parents' education	.24	-.04	.52	.03	-.25	.30
Number of books	-.03	-.28	.22	-.02	-.27	.22
Reading enjoyment	**.33**	**.07**	**.58**	**.34**	**.08**	**.59**
Home learning activities	**.25**	**.03**	**.47**	**.26**	**.04**	**.48**
Residual variance	.70	.48	1.05	.64	.41	.98
Teacher variables						
Teacher's perceived ability	-.09	-.39	.19	-.04	-.35	.25
Providing online instruction	-.11	-.39	.15	-.22	-.51	.08
Providing worksheets	.09	-.19	.34	.12	-.16	.38
Differentiation of instruction	.15	-.14	.43	.28	-.02	.58
How challenging they found	.21	-.08	.52	.03	-.29	.36
Intercept	.00	-.22	.24	.02	-.21	.28
Residual variance	.07	.00	.38	.15	.01	.55
Model 2: With autoregressor						
Child variables						
Autoregressor	**.48**	**.26**	**.69**	**.48**	**.28**	**.68**

Parents' education	.06	-.19	.31	.13	-.11	.36
Number of books	-.04	-.26	.18	-.11	-.31	.10
Reading enjoyment	**.29**	**.06**	**.51**	.21	-.02	.44
Home learning activities	**.20**	**.00**	**.39**	**.20**	**.02**	**.39**
Residual variance	.53	.36	.80	.45	.28	.69
Teacher variables						
Teacher's perceived ability	-.08	-.32	.16	-.07	-.32	.17
Providing online instruction	-.05	-.28	.19	-.11	-.35	.12
Providing worksheets	.07	-.18	.31	.07	-.16	.30
Differentiation of instruction	.21	-.06	.46	**.28**	**.04**	**.54**
How challenging they found	.00	-.29	.27	.01	-.27	.27
Intercept	.00	-.22	.19	.01	-.21	.22
Residual variance	.05	.00	.25	.11	.01	.42

Note. Bold font indicates the significant effects. CI = credible interval; Est = estimate; LL = lower limit; UL = upper limit.

Discussion

The purpose of this study was to examine whether different parent- and teacher-related factors influenced at-risk children's reading performance during the COVID-19 pandemic. Before we discuss the results related to our research questions, it is important to note four other interesting results. First, even though most of our participants continued to experience reading difficulties at Time 2, they did not lose ground in their reading performance (based on the fact that their standard scores remained largely the same over time). This could be seen as relatively good news because preliminary evidence has shown that COVID-19 played out harder for some groups of children like those with learning disabilities (e.g., Georgiou, 2021). Second, teachers reported that on average they provided online reading instruction and worksheets focusing on

reading 1–2 days a week. Even though we did not ask if the worksheets were accompanying their online teaching of reading or if they were given on the days there was no online teaching, providing reading instruction 1–2 days a week is too little for Grade 1 students, particularly for children identified as being at-risk for reading difficulties and who would have received reading intervention four times a week had COVID-19 never happened. Third, intraclass correlations in both reading tasks increased over time (particularly in WIAT pseudoword decoding), possibly suggesting larger differences between teachers in their online teaching than in their in-class teaching. Finally, given that teachers' perceived ability to teach struggling readers was not correlated with any of the students' reading outcomes, we could argue that similar to existing results (Stark et al., 2016; Washburn et al., 2011), they may not be particularly accurate at estimating their own ability to teach at least the word reading skills that WRAT and WIAT most closely assess.

In regard to the role of different parent- and teacher-related factors in at-risk children's reading performance, our findings were consistent across the reading outcomes. Of the different parent-related factors, only home learning activities had a unique effect on children's reading skills and their effect remained significant even after controlling for the effects of the autoregressors. This finding reinforces those of previous studies showing a significant effect of HLE experiences on children's early reading skills (e.g., Inoue et al., 2020; Lehrl et al., 2020; Manolitsis et al., 2011; Sénéchal & LeFevre, 2002; Zhang et al., 2020). However, our finding is in contrast to those of previous studies showing no significant effects of parental teaching in children's reading among Grade 1 struggling readers (Inoue et al., 2018; Silinskas et al., 2013). It is possible that the new realities created by Covid-19 pandemic with reduced school instructional time forced parents to take a more active role in their children's teaching, which, in turn, resulted

in some positive effects. For example, Aram et al. (2022) showed that the frequency of shared book reading at home increased during Covid-19 compared to what it was before Covid-19. In contrast to home learning activities, ALR did not have a significant effect on children's reading. There might be two explanations for this finding. First, our sample consisted of predominantly White, middle-class families with limited variability in book provision. Second, it is possible that during Covid-19, it was not the actual number of books that made a difference but how much time children spent on digital devices that included reading related content. Unfortunately, we did not assess how much time children spent reading on electronic devices.

Frequency of reading for enjoyment was also a significant predictor of children's reading skills and its effect survived the statistical control of the autoregressor (when predicting WRAT Word Reading). This is in line with recent findings (Torppa et al., 2019) and suggests that the amount of time children spend reading independently is important because it gives children (particularly those at risk for reading difficulties) opportunities to practice words they know (thus enhance the orthographic representations of these words in memory), opportunities to decode words they encounter for the first time (see Share's, 1995, self-teaching hypothesis), and opportunities to have further discussions about what they read with their parents.

Among the teacher-related factors, only differentiation of instruction was a significant predictor of children's reading skills at Time 2 and only when predicting WIAT pseudoword decoding in the model with the autoregressor. This finding should be seen in conjunction with the large intraclass correlation for WIAT pseudoword decoding at Time 2. As indicated earlier, one interpretation of the observed increase in the intraclass correlations is that it may suggest larger differences between teachers in their online teaching than in their in-class teaching. Given the reported challenges of teachers in teaching online (particularly in early grades when students

were not used to be spending much time in front of a monitor; see van der Spoel et al., 2020), it would be fair to assume that differentiation of instruction for struggling readers was more difficult to achieve. Obviously, those teachers who managed to differentiate their instruction for their struggling readers had a stronger impact on their decoding skill development. This view is reinforced by our earlier findings from classroom observations in the same classroom context showing that the teachers' ability to differentiate instruction was a significant predictor of their children's future decoding skills (Parrila et al., 2023). In regard to the other teacher-related factors, there might be four explanations for their non-significant effect. First, it is possible that these factors do play a significant role when predicting children's reading skills, but only when considering all ability levels and not just those of at-risk children (e.g., Kikas et al., 2018). Second, the teacher effects may have been consistent across all at-risk children in our sample, which then led to non-significant effects in their reading skills. Third, it is possible that it is not the frequency of providing online reading instruction or reading materials but the quality of the provided instruction and materials during that time that matters. Unfortunately, we could not evaluate the quality of the online lessons or the provided materials. Finally, because during the school closures children spent relatively little time online with their teachers compared to the time they spent with their parents, variables related to teachers did not play a significant role in these children's reading development.

Limitations

Some limitations of the present study should be noted. First, any significant effects reported in our study do not imply causation. Additionally, our sample was relatively small and our findings should be interpreted with some caution. Second, we measured both parent- and teacher-related factors using a questionnaire. As indicated by some researchers (e.g., Inoue et al.,

2020; Manolitsis et al., 2011), questionnaires are subject to social desirability bias (i.e., parents responding based on what the society values and not based on what they actually did). Unfortunately, because of the COVID-19 pandemic and the health protocols in place, it was impossible to visit houses to examine in vivo what the parents were doing with their children. Third, our parent and teacher questionnaires were relatively brief. We intentionally kept them brief because parents and teachers were stressed during the pandemic (Garbe et al., 2020; Jakubowski & Sitko-Dominik, 2021) and would have been less willing to fill out long surveys. We acknowledge that our choice may have concealed important aspects of the home environment (e.g., what kinds of parent-child interactions had the greatest impact). Thus, our findings cannot contribute to the discussion around the role of code- versus meaning-related activities on children's reading performance. Fourth, we did not ask parents to indicate if they were experiencing any reading difficulties themselves. This is important because even if they were willing to help their children, their own reading difficulties could affect the quality of the assistance they provided. Unfortunately, COVID-19 produced a lot of variation in home situations: Some parents were furloughed on full pay and had additional time, others lost their jobs, whereas yet others were working extra-long hours. We have no index of parents' work situations in our study and its possible consequences on parenting. Finally, our sample consisted of predominantly White middle-class families. Thus, our findings may not generalize to other ethnicities and socioeconomic groups. This is important to keep in mind in view of evidence that COVID-19 had a greater impact on low-income families and Black or Indigenous children (see Kuhfeld et al., 2023). These groups were either poorly or not at all represented in our sample.

Conclusion

To conclude, our findings add to those of previous studies that examined the HLE (or aspects of it) during the pandemic (e.g., Aram et al., 2022; López-Escribano et al., 2021; Sonnenschein et al., 2021) by providing preliminary evidence that home learning activities during school closures had an effect on at-risk children's reading kills. What seems to be playing an even more important role for this group of children is the frequency of reading for enjoyment. Independent reading may not exert a unique effect on future reading ability in samples of typically developing children (Silinskas et al., 2020), but may be critical for children with reading difficulties. In contrast, among the teacher-related factors, only differentiation of instruction played an important role in at-risk children's reading skills. Taken together, these findings reinforce the important role of parents in their children's early reading development particularly when the typical agents of instruction (i.e., teachers) have less time and opportunities to interact with their students because of the pandemic.

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Chapter 3: Efficacy of Small Group Reading Intervention For Grade 2 and 3 Struggling Readers During COVID-19 Pandemic: A Randomized Control Trial

Introduction

Learning to read is undoubtedly one of the most important skills children are asked to master in their early school career. Early reading difficulties have been associated with higher dropout rates, unemployment, mental health problems and even incarceration (e.g., Aro et al., 2019; Jordan & Dyer, 2017; Parhiala et al., 2015). Research has also shown that the COVID-19 pandemic amplified reading difficulties particularly for children in early grades (e.g., Georgiou, 2021; Kuhfeld et al., 2023). Given that 75% of the children who do not overcome their reading difficulties by Grade 3 never read at grade level later on (Torgesen, 2002), it is imperative to provide early reading intervention. Thus, the overall goal of this study was to examine the effects of two theory-driven reading interventions on struggling readers' performance.

In the last two decades, both classroom reading instruction and 'pull-out' interventions in English have been heavily influenced by research on phonics, which emphasizes the systematic teaching of connections between graphemes and phonemes. Because English spellings are based on an alphabetic system in which the primary purpose of letters is to represent sounds (Wyse & Goswami, 2008), all children should first be taught grapheme-phoneme correspondences (GPCs) to be able to decode both familiar and unfamiliar words. In support of this argument, several intervention studies have shown that phonics produces better results than alternative methods that do not target GPCs (see e.g., Ehri et al., 2001; Galuschka et al., 2014; McArthur et al., 2018;

Slavin et al., 2011, for evidence from meta-analyses). For example, in their meta-analysis of 22 randomized control trial reading interventions, Galuschka et al. (2014) found that phonics was the only method that had a significant, albeit moderate, effect on word reading (Hedges' $g = .32$).

However, English is known to have an opaque orthography, meaning that not all words can be read accurately by applying the GPC rules (Seidenberg & McClelland, 1989; Seymour et al., 2003). The words that violate the one-to-one correspondence between letters and sounds are called irregular words (e.g., said, there, through). It has also become clear to researchers that there are a number of complexities involved in phonics programs. Complexities frequently emerge from the fact that strings of phonemes produced during phonic assembly may be distinct from stored words. For example, children must match the phoneme string /k - æ - t/ each with an individual schwa /kuh - ah- tah/ in the stored word 'cat' or /t - ɔɪ - z/ as in the stored word 'toys' where the voiced nasality of the diphthong 'oy' is carried over into the 's', changing its pronunciation into the voiced phoneme /z/. Phoneme strings and words are thus fundamentally different and the task of matching the two, assumed in standard phonics but rarely taught, may not be trivial to (some) children. Among the reasons the two are different are that words have these co-articulated phonemes (take on qualities of sounds that precede or follow them), but other reasons may be that the words contain 'exceptions' to or variants on the most common phonic rules and in the case of polysyllables, the stress assignments create distance in the unstressed syllable(s).

To address these complexities, Tunmer and Chapman (2012) proposed a "2-step model of word decoding" that posits the existence of a second-step in decoding – the linking of a spelling pronunciation to a word representation undertaken *after* children have created phoneme strings.

This second step requires children to have a flexible mental "Set for Variability" (S*f*V) to match pronunciations derived from GPCs to entries in their mental lexicon (e.g., Elbro et al., 2012; Staecy et al. 2023; Tunmer & Chapman, 2012; see also Boldrini et al., 2023). The term "Set for Variability" is rooted in the work of Gibson (1965) and Venezky (1999), who suggested that in order for English-speaking children to be successful in using phonics they should also develop a "set for variability". More specifically, Venezky (1999) stated that "if what is first produced does not sound like something already known from listening, a child has to change one or more of the sound associations (most probably a vowel) and try again" (p. 232).

Studies have shown that Set for Variability (S*f*V) can be trained in children (Colenbrander et al., 2022; Dyson et al., 2017; Savage et al., 2018; Zipke et al., 2016). To examine the added benefit of teaching S*f*V to at-risk children's reading ability, Savage et al. (2018) conducted an intervention study that involved two sites in Canada (Quebec and Alberta). They followed a group of Grade 1 children from a first pre-test (September) to a second pre-test (December), to a post-test (May), and to a delayed post-test administered in the fall of Grade 2. In the Phonics + S*f*V condition, children received intensive instruction on GPCs as well as on variable pronunciations (e.g., for *s*, *c*, *g, th*) that systematically taught them to blend these phonemes to pronounce words. Savage et al. (2018) showed that there were statistically significant advantages at post-test for the Phonics + S*f*V program over the control group (they had phonics and sight words both taught in the traditional way that promoted rote memorization) on measures of word reading and spelling. Advantages favoring the S*f*V group remained for word reading and sentence comprehension at delayed post-test at the beginning of Grade 2, five months after the intervention had finished. Positive effects of S*f*V have also been reported in a recent study by Colenbrander et al. (2022) that compared different methods of instruction for

teaching irregular words. In their study, 85 Kindergarten children were randomly assigned to the Look and Say (LSay), Look and Spell (LSpell), Mispronunciation Correction (MPC; i.e., S*f*V), or wait-list control condition. Children were taught 12 irregular words over three sessions controlling for instructional time and the number of exposures to written and spoken words across conditions. Children showed evidence of superior learning of trained words in the MPC and LSpell conditions, compared to LSay and controls. Differences between the MPC and LSpell conditions were not significant.

However, we also know that English is a morphophonemic language in that spellings have evolved to represent both phonemes and meaning (through morphology and etymology). As Venezky (1967) pointed out "the present [English] orthography is not merely a letter-to-sound system riddled with imperfections, but, instead, a more complex and more regular relationship wherein phoneme and morpheme share leading roles" (p. 77). If we accept that the purpose of literacy instruction is to help children understand how their writing system works, then children should be exposed not only to GPCs, but also to the interrelations between phonology and morphology. As a result, some researchers turned their interest to interventions targeting other linguistic skills such as morphological awareness (e.g., Crosson et al., 2021; Georgiou et al., 2021; Lyster et al., 2016; Mulder et al., 2022). In their meta-analysis of morphological awareness intervention studies, Bowers et al. (2010) reported significant effects of morphology instruction on literacy skills and further indicated that morphology interventions work better for struggling readers and younger children (preschool to Grade 2) compared to older children (Grades 3 to 8).

The Present Study

To date, even though we have evidence showing that Phonics + S*f*V produces significant results for struggling readers in early grades (e.g., Savage et al., 2018), to our knowledge, no

studies have examined the effects of combined phonics and morphology instruction. Given that English is a morphophonemic language, teaching both phonics and morphology within the same intervention condition seems logical. Thus, a subgoal of this study was to examine if the two intervention programs that put an equal emphasis on phonics (hence, expected to be effective for all), but differ on the added component (set for variability vs. morphology) would produce differential effects on children's reading performance.

We aimed to answer the following two research questions:

1. Did reading intervention improve struggling readers' reading performance? We expected that both reading interventions would improve children's reading performance from pre-test to post-test with no significant changes from post-test to delayed post-test.
2. Did Phonics + S*f*V produce better results in irregular word reading than Phonics + Morphology? We expected that Phonics + S*f*V would lead to significantly higher performance in measures of irregular word reading (see below for details) than Phonics + Morphology.

Method

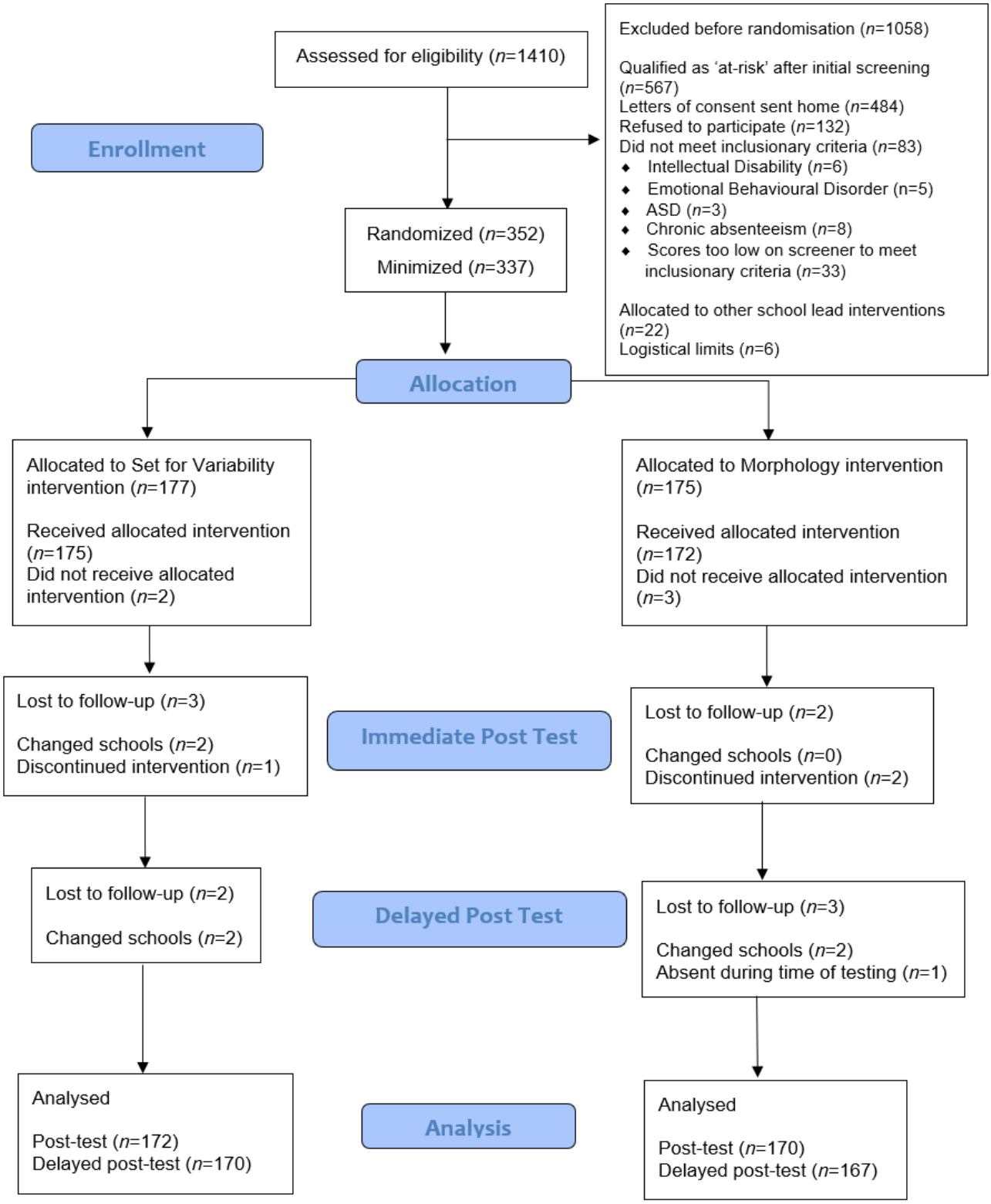
Research Design

The study was a quasi-experimental pre-/post-/delayed post-test Tier 2 intervention Randomized Control Trial (RCT) with Grade 2 and 3 struggling readers. Prior to recruiting our participants, we performed a power analysis to determine the number of classes (Level-2) required for the study. The analysis revealed that with a conventional alpha of .05, approximately $n = 80$ classes would be sufficient to detect an effect size of .25 with the conventional power of .80. This sample size also allowed for expected attrition and control for possible moderating factors (Raudenbush & Bryk, 2002).

A true random number generator (www.random.org) was also used to allocate the classes to conditions by first creating a 1 or 2 number code to represent the two intervention conditions. Three hundred fifty-two Grade 2 and 3 children from 86 classrooms nested within 24 schools across four school divisions in Alberta were recruited to participate in the study. Of the 86 classes, 41 classes were assigned to Condition 1 (Phonics + Set for Variability), 44 classes to Condition 2 (Phonics + Morphology), and one class ended up withdrawing from the project. A CONSORT flow diagram[2] of all participants in the study is reported in Figure 1.

[2] CONSORT flow diagrams are frequently used in experimental studies to demonstrate the flow of participants through the different phases of the experiment.

Figure 1 *ITT Analysis Consort Flow Diagram of Participants*



Participants

The participants were selected in a stepwise fashion. First, during the second week of September 2021, the teachers of 85 Grade 2 and 3 classes in the four participating school divisions assessed 1,410 children in the three reading screeners (Sight Word Reading Efficiency and Phonemic Decoding Efficiency from the Test of Word Reading Efficiency [TOWRE-2; Torgesen et al., 2012], and the Test of Silent Word Reading Fluency-2 [TOSWRF-2; Mather et al., 2014]). Students were thought to have reading difficulties if their scores were below a standard score of 90 in at least two out of three screening measures. A standard score of 90 corresponds to the 25th percentile, which is commonly used to identify children who have reading difficulties. All the teachers had received training through school wide in-services on how to implement and score each measure. Note that most of them were already using the same assessments as part of their reading assessment routine. The Grade 2 and 3 children's scores were shared with the research team whereby the first author reviewed them to identify the qualifying children.

After the initial screening, we found 567 children that qualified to receive intervention. This corresponds to 40% of the students in the initial sample (n =1,410). With the assistance of school principals, and literacy coordinators assigned to the study, these 567 children were then screened for additional exclusion criteria. Children were excluded if:

1) they were identified as having an intellectual, sensory, or behavioral difficulty (e.g., Code 42; Special Education Coding Criteria, Alberta Education, 2021);

2) they had a history of severe absenteeism (if they were frequently absent, it was reasonable to expect that they would not receive the right amount of intervention in order to improve); and/or

3) they performed below a standard score of 60 on two out of three of the screening measures. This decision was made because children with these scores showed very limited letter knowledge, a prerequisite to phonics instruction. These students would require a different kind of intervention.

Subsequently, 83 children were excluded leaving our sample with 484 potential participants. To conclude the screening phase, these children were formally invited to participate in the study by sending a letter of information about the study and a consent form to their parents. Ethics permission for this study was obtained from the research ethics board of the University of Alberta (No. Pro00111077). In addition, written consent was obtained from parents.

Of the 484 invitees, 352 (185 females; 167 males; M_{age} = 7.67 years at pre-test, SD = .68) obtained parental consent (72.7% return rate) and moved onto the next phase of the study. The children who did not receive parental consent did not participate in our intervention.

One hundred and seventy-seven children from 41 classes were assigned to Condition 1 and 175 children from 44 classes to Condition 2. A total of 15 students (4.3% of the total sample: 2.8% from condition 1 and 1.5% from condition 2) withdrew from the study right after the intervention commenced. Some of these students moved to a different school division or their parents withdrew their parental consent. At immediate post-test, 1.5% of the total sample (0.9% from Condition 1 and 0.6% from Condition 2) was not available to be tested. Additionally, 1.5% of the total sample (0.6% from Condition 1 and 0.9% from Condition 2) was not available to be

tested at delayed post-test (most often because children tested positive for COVID-19 and were absent during testing). This resulted in 337 Grade 2 and 3 children (177 females, 160 males; M_{age} = 7.66 years, *SD* = .69) having data at all time points.

Materials

Children were assessed four times: at the screening phase (second week of September 2021), at pre-test (last two weeks of September 2021), post-test (last two weeks of February of 2022), and delayed-post-test (last two weeks of May 2022). The screening was carried out by the classroom teachers and the rest by trained examiners. Parents of the participating children also filled out a brief questionnaire with some background information.

Parent Questionnaire

Parents filled out a questionnaire at the beginning of the study to collect some background information on the participating children. The questionnaire included the following seven questions: (1) whether their child had normal or corrected hearing and vision; (2) whether their child had a diagnosed learning disability (yes, no and if yes, then what kind of learning disability); (3) what was the mother's highest achieved educational level; (4) what was the father's highest achieved educational level; (5) what was the mother's occupation; (6) what was the father's occupation; and (7) if English was spoken at home.

Screening Measures

To be eligible for intervention, all Grade 2 and 3 children in the participating schools were screened on Sight Word Reading Efficiency and Phonemic Decoding Efficiency from TOWRE-2 (Torgesen et al., 2012), and on TOSWRF-2 (Mather et al., 2014).

Sight Word Reading Efficiency. In Sight Word Reading Efficiency, children were asked to read a list of 108 real words, divided into four columns of 27 words each, as fast as possible (e.g., *in*, *go*, *dog*). A participant's score was the total number of words read correctly in 45 seconds.

Phonemic Decoding Efficiency. In Phonemic Decoding Efficiency, children were asked to read a list of 66 pseudowords, divided into 3 columns of 22 pseudowords each, as fast as possible (e.g., *ip*, *ko*, *pim*). A participant's score was the total number of pseudowords read correctly in 45 seconds.

Silent Word Reading Fluency. In TOSWRF-2, children were presented with 32 rows of words with no spaces between them (e.g., *dimhowfigblue*). Children were given 3 minutes to identify and draw a line between the boundaries of as many words as possible (e.g., *dim/how/fig/blue*). A participant's score was the number of words correctly identified within the 3-minute time limit. In all three screening measures, the raw score was converted into a standard score following the instructions in the respective manuals.

Pre-test, Post-test, and Delayed Post-test Measures

Nonverbal IQ. Children were assessed on nonverbal IQ with the Cognitive Assessment System (CAS2-Brief) Simultaneous Matrices (Naglieri et al., 2014) only at pre-test. In Simultaneous Matrices, children were presented items with an array of shapes and geometric designs that were interrelated within a visual matrix. From six possible choices, children were asked to select one picture that would accurately complete the visual matrix. The items were arranged in terms of increasing difficulty and the task was discontinued after three consecutive errors. A participant's score was the total number correct (max = 44). In this task, the raw score

was converted into a scaled score following the instructions in the manual. Cronbach's alpha reliability in our sample was .94.

Vocabulary. The Listening Comprehension subtest of the Wechsler Individual Achievement Test 3 (WIAT-III; Wechsler, 2009) was used to assess children's receptive vocabulary knowledge. Children were told a word by the tester and asked to preview a set of four pictures, then point to the one picture that correctly represented the word. For example, the tester would say '*empty*. Point to the picture that shows *empty*'. The items were ordered in terms of increasing difficulty. The task was discontinued after four consecutive errors and a participant's score was the total number of correctly identified words (max = 19). In this task, the raw score was converted into a standard score following the instructions in the manual. Cronbach's alpha reliability in our sample was .90.

Phonological Awareness. The Phoneme Elision subtest of the Comprehensive Test of Phonological Processing 2 (CTOPP-2; Wagner et al., 2013) was used to assess phonological awareness. Children were first asked to repeat a word that was provided orally by the tester and then say what was left in the word after smaller parts were taken away. For example, the tester would say '*Say mat. Now say mat without saying /m/*'. The task was discontinued after three consecutive errors and a participant's score was the total number correct (max = 33). In this task, the raw score was converted into a scaled score following the instructions in the manual. Cronbach's alpha reliability in our sample was .94.

Morphological Awareness. The Inflection and Derivational Word Analogies task from Kirby et al. (2012) was used to assess morphological awareness. The task consisted of two subtests, one of ten inflectional and one of ten derivational items, given in a fixed order. Children were asked to say out-loud the missing word based on a pattern from a set of words (e.g., run:

ran, walk: *walked*). The tester would say: 'I am going to ask you to figure out some missing words. If I say *push* and then I say *pushed*; when I say *jump*, then I should say…?'. If children did not complete the analogy correctly by responding *jumped*, the tester would provide feedback by explaining how each pair were alike. The same procedure was followed for the other two practice items. No feedback was given during the test items. The task was discontinued after the participant made four consecutive errors on each of the inflection and derivational subtests. A participant's raw score was the total number of inflected and derived items correct (max = 20). Cronbach's alpha reliability in our sample ranged from .82 to .86.

Word Reading Tasks

We administered four measures of word reading: the Word Reading task from WIAT-III (Wechsler, 2009), the Set for Variability reading task (Tunmer & Chapman, 2012), the Castles and Coltheart-3 (CC3) reading task (Castles, 2022), and an experimenter-designed word reading task with words trained during the intervention.

Word Reading. In the Word Reading subtest from WIAT-III (Wechsler, 2009), children were asked to read words from a list of 75 words arranged in increasing difficulty. The task was discontinued after five consecutive errors and the score was the total number of words read correctly (max = 75). The raw score was converted into a standard score following the instructions in the manual. Cronbach's alpha reliability in our sample ranged from .93 to .96.

Set for Variability. The Set for Variability task (Tunmer & Chapman, 2012) was administered to assess children's ability to determine the correct pronunciation of irregular words that were "mispronounced" based on a regularized decoding (e.g., /brikfəst/for/brɛkfəst/). The tester would orally provide the regularized word and then ask children to tell him/her back the

actual word. Before attempting the test items, children completed three practice items to ensure they understood the instructions. Feedback was provided only during the practice items. Children were asked to try all 18 words and a child's score was the total number of words pronounced correctly (max = 18). Cronbach's alpha reliability in our sample ranged from .84 to .86.

Castles and Coltheart 3 (CC3). The Castles and Coltheart 3 (Castles, 2022) reading task was used to assess children's ability to read sets of regular, irregular, and nonwords each containing four cards with 10 words on each card. The cards in each set increased in difficulty. Children began with Regular Word Card 1 and were asked to read all 10 words on the card. If children read 6 or more words correctly, they were asked to attempt Regular Word Card 2, then Card 3 and then Card 4, respectively. The procedure continued until 5 or more errors on a regular word card were made. Children would then move onto attempting the Irregular Words set followed by the Nonwords set with the same discontinuation rule applied. A participant's raw score was the total number of words read correctly in each set (max = 40). Cronbach's alpha reliability in our sample ranged from .92 to .95.

Intervention Word Reading. Finally, the experimenter-designed word reading task was used to assess students' ability to read regular and irregular words that were taught in the intervention, and nonwords that were derived from real words taught in the intervention.

Each lesson in the intervention included a selection of regular words that contained the taught GPC. As students progressed through the lessons, the regular words they read were built from previously learned GPCs and increased in pattern complexity (i.e., VC, CVC, CVCC,…). The irregular words were selected from Fry's 300-word list (Fry, 1980, 2006) and served two purposes. First, in both conditions, they provided a suitable starting point for the readers, and

second, they enabled children in Condition 2 to build word sums (e.g., use + ful → useful), a review component of morphology instruction. The nonwords were created with an online pseudoword generator. Children were asked to read from three different lists that each contained 12 words of increasing difficulty: (1) Regular Words, (2) Irregular Words, and then (3) Nonwords. Children were asked to attempt all the words from each list. A participant's score was the total number of words read correctly (max = 36). Cronbach's alpha reliability in our sample ranged from .89 to .92.

Procedure

Children were assessed individually in a quiet space at their respective school and testing lasted approximately 45 minutes each time. The testing at pre-test, post-test and delayed post-test was carried out by trained Research Assistants (RAs) and district literacy consultants assigned to the study. All RAs and literacy consultants held, or were studying for, a range of degrees from education or psychology programs (B.A., B.Ed., M.Ed., and Ph.D.), with many having teaching experience or additional course work in education and experience with delivering similar testing in the past. Training sessions on how to deliver the test battery were delivered by the project manager. Training lasted approximately 2-3 hours in length and included mock administration of tasks and scoring. All testers were asked to send their first two completed assessment booklets to the first author for review prior to continuing their testing. Once the assessments were deemed accurately administered, RAs resumed testing. Two senior RAs were responsible for double checking all scoring of the data, data entry, and the calculation of derived scores. Inter-rater reliability for scoring was .99.

Delivery of Interventions

The small group interventions began in the fall term immediately after the pre-test. Interventions were run with groups of 2-4 students outside of the classroom in a dedicated quiet space for 30-minute sessions, 4 times a week (3 lessons + 1 review lesson) over 15 weeks. Students received an average of 26 hours of intervention (some students had missed some intervention lessons and this is why the average number of hours is less than 30). Teachers and EAs assigned to the delivery of Condition 1 (Phonics + Set for Variability) were trained by the second author while the first author trained the Condition 2 (Phonics + Morphology) group. A group training session was held for each condition in different locations and lasted approximately two hours. In these sessions, each trainer gave an overview of the intervention goals, reviewed the scope and sequence of lessons, and demonstrated one lesson plan in detail, acting out different scenarios that could arise. Interventionists had the opportunity to review their intervention materials with other interventionists in their group and ask questions to clarify their understanding of the content. During the intervention, the interventionists were encouraged to contact the first or second author to ask any questions. Feedback was given in a timely manner through email and/or videoconferencing, and on-site coaching was provided by literacy consultants when required. Approximately two weeks into the intervention, a recording of a proficient intervention lesson of each condition was viewed by all interventionists and trained observers. This was done for two reasons: (a) to remind them of the key features of their intervention condition and (b) to increase the treatment fidelity.

Intervention Lessons

Each intervention condition was designed to cover 45 letter-sound correspondences and explicitly teach 49 irregular words that frequently occur in children's books. The irregular words used in the intervention lessons were selected from Fry's 300-word list (Fry, 1980), a common

list that is referenced and included across Grade 1 to 3 language arts curricula (Fry & Kress, 2006). Each intervention condition also included 15 review lessons that gave children the opportunity to practice their learning at the end of each week with game-like activities and shared book reading.

In each 30-minute lesson, children were given small group instruction in phonological awareness and phonics focusing intensively on the explicit teaching of high-frequency letter-sound correspondences through the direct mapping of text that progress from simple to more complex letter patterns. Children were taught alternative strategies for decoding irregular words in the two conditions and engaged with real books through shared book reading instruction. Applying phonics knowledge to authentic experiences with real books has been shown to increase the number of words a child can read independently, support the application of letter-sound knowledge to decoding parts of irregular words, and enhance overall engagement and motivation in reading (e.g., Savage et al., 2018, 2020).

Both intervention conditions were taught in the following lesson sequence:

1) Review previously learned GPC/Phonemic Awareness drill (3 minutes). In addition to briefly reading the previous day's GPC in isolation and reading words that contained the GPC, children were guided through a quick phonological awareness drill that targeted manipulating sounds at the oral level.

2) Introduce the GPC of the day and practice decoding regular words (10 minutes). Children were introduced to the GPC of the day (e.g., the GPC <b>, /b/). Next, they were explicitly taught how to blend letter-sounds together to decode regular words that contained the target GPC.

3) Irregular Word Practice (5 minutes). In this step, children were explicitly taught how to decode an irregular word using a specific strategy. Whereas in Condition 1 the Mispronunciation Correction strategy was used, in Condition 2, the morphology strategy was used to teach irregular words.

4) Shared Book Reading (10 minutes). In this part of each lesson, children were exposed to a variety of words that contained the GPC of the day through an interactive shared book reading experience. Along with the children, the interventionist read the text aloud, pausing at different places, encouraging each child to identify, and read words they knew and decode words that contained the newly learned GPC.

5) Wrap-up (2 minutes). In this final step, children were asked to repeat the GPC of the day and to say a word they learned that contained the GPC.

Phonics + Set for Variability (S*f*V). In Condition 1, the S*f*V was used to explicitly teach the decoding of irregular words (see Appendix A, for a sample lesson). Mispronunciation Correction (MPC) is an S*f*V strategy that utilizes lexical knowledge and context to derive an approximate pronunciation for a printed word to correct an imperfect pronunciation (Dyson et al., 2017). With MPC, children work through a series of reflections to determine if the word makes sense and, if not, they are guided to recognize an 'irregular grapheme-phoneme correspondence' that might need to be flipped or substituted using another. If children do not know another GPC that fits, or if the word pronounced does not make sense, they think about the pronunciation of the word in the context of a sentence. Interventionists explicitly taught children the MPC strategy using the following five steps:

1) Sound out the word by blending the phonemes together. (Blend phonemes of a letter string by applying phonic rules.)

2) Ask yourself if this is a word you know. (Evaluate whether the pronunciation yields a recognizable word.)

3) If it is not a word you know, try swapping one or a few of the sounds for different sounds, or try to think of a word you already know that sounds similar. (Identify an alternative vowel pronunciation or similarly pronounced word.)

4) If it is still not a word you know, read it in a sentence for more information to see if you know a similar sounding word that makes sense in the sentence. (Consider the word's context, then synthesize a revised phoneme string.)

5) You sound out the word, say the word, and write it down. (Re-evaluate and reflect upon the word and the above process.).

Every fourth lesson, the children review the letter-sounds, regular and irregular words they learned from the week (see Appendix B, for a sample lesson). Then they work in partners or with the teacher on Word Work where they review building and decoding words through a variety of games and activities. This 30-minute review lesson ends with shared book reading.

Phonics + Morphology. In Condition 2, children were taught morphology to read irregular words (see Appendix C, for a sample lesson). An adaptation of Structured Word Inquiry (SWI) by Bowers (2009) was taught emphasizing the identification and manipulation of morphemes (the smallest meaningful units in words). SWI is an instructional framework that guides children through investigating the spelling–meaning–pronunciation connection in words. The four main questions in SWI are:

(1) What is the meaning of the word?

(2) How is the word built (can any bases or affixes be identified with a word sum)?

(3) What related words can you find (morphological relatives that share a base)? and

(4) What graphemes function coherently? (representation of phonemes across morphological boundaries).

A central component of SWI is spelling aloud as you write words. For example, with the word <knight>, a child is asked to spell out the base 'kn - igh - t' and explicitly associate the digraph with the phoneme /n/, the trigraph with the phoneme /aI/ and the single-letter grapheme with the phoneme /t/. Within the framework of a word sum, children are guided to announce prefixes (e.g., <un->, <dis->, <re->) and suffixes (e.g., <-ed>, <-ment>, <-ure> and <-ing>). Word sums show the morphological structure of individual words in a matrix. Once word sums are sufficiently practised, children may be guided to build a word matrix. A matrix has a central base that can be combined with other morphological elements (bases and affixes) to form complex words. Word sums show the morphological structure of individual words in a matrix. The vertical lines in the matrix correspond to the plus sign in the word sum. Horizontal lines cannot be crossed to form words. The matrix shows the full form of written morphemes in the cells, but the word sum can show suffixing changes (e.g., make/ + ing ➔ making; hop(p) + ing ➔ hopping; and try/i + es ➔ tries). The matrix and word sums provide concrete representations of the underlying morphological structure of words and the surface realizations that we see in print.

Similar to Condition 1, children complete a 30-minute review every fourth lesson (see Appendix D, for a sample lesson). They revisit the letter-sounds and words they learned from the

week, and complete one Word Work activity and shared book reading. In contrast, they perform an activity called Morpheme Morph where they read a word matrix to build and write word sums (e.g., large + ly → largely).

Treatment Integrity

To assess Treatment Integrity (TI), interventionists in each condition were observed multiple times by trained observers. The observers included the first and second authors, and literacy consultants that received 1-hour of training on the role and structure of TI in the interventions and included the viewing a 30-minute video recording that demonstrated the "proficient" delivery of a sample lesson. An experimenter designed TI rubric (adapted from Savage et al., 2018) was designed to evaluate five main areas of lesson delivery: 1) Content Completion, 2) Order of Content Delivery, 3) Time Management, 4) Quality of Instruction, and 5) Student Behavior. Under the Quality of Instruction category, interventionists were observed and scored on understanding of lesson content, communication of the content, and skill in addressing individual student needs. Each component was scored with a 3-point scale (0 = "insufficient", 1= "limited", 2= "proficient"). Seven interventionists that obtained a score of 1 or 0 were given additional training (approximately 3 hours long) and guidance by the project coordinator or literacy consultant assigned to the condition and were observed again. Eight weeks into the intervention, one interventionist was replaced by a newly trained interventionist due to consistently low scores.

Overall, two intervention sessions were independently observed by either two literacy consultants, the project coordinator or the project supervisor to ensure ongoing inter-rater reliability. Analyses of all these scores showed 98% agreement in Phonics + S*f*V and 97% in Phonics + Morphology interventions. Mean scores for each observer were calculated for all

observed sessions separately for each of the five TI components. Mean rankings were uniformly high (e.g., 1.73 to 1.89 on a maximum possible score of 2). Mann-Whitney U tests for each TI component by condition (Phonics + S*f*V vs. Phonics + Morphology) adjusting for multiple contrasts were nonsignificant (all *p*s > .10), confirming that both interventions were equally well implemented.

Data Analysis

Data analysis involved three steps. First, we conducted a preliminary analysis on all data to check for any deviations from normality (i.e., performance ±3 *SD*s from the group's mean) and for any group differences on extraneous variables (e.g., general cognitive ability, age and gender distribution). Second, we performed Hierarchical Linear Modeling (HLM) to determine if there was a significant main effect of the intervention condition on the outcome measures at post-test and delayed post-test. HLM is an advanced regression technique that is used to analyze variance in outcome variables when the predictor variables are at varying hierarchical levels; for example, children (level-1) in a classroom (level-2) share variance according to their common teacher and common classroom. HLM is recommended for dealing with nested data because it can distinguish individual and group effects on the multiple continuous and discrete outcome variables and control for Type-1 error (Raudenbush & Bryk, 2002). Finally, we calculated effect sizes. Effect sizes were calculated using the difference between the respective pre, post- and delayed post-test means as the numerator and the pooled pre-test standard deviation as the denominator (Cohen, 1988).

Results

Preliminary Data Analyses

Missing Data

There was only a modest loss of data in the main attainment database: 1 child was lost prior to randomisation, 1 child was removed by his/her school after randomisation but before testing, and 4 children were assigned to conditions, but no data was collected at any point. There were 11 children with missing data at one or other post-test (6 at post and 11 at delayed post-test). The total missing data made up less than 1% (0.02%) of the total test data, and were missing completely at random, Little's Missing Completely at Random (MCAR) test (χ^2 = 403.98 *df* = 375, *p* = .145), so Multi-Level Modelling could safely be run on data as is without introducing confounds. Missing data on the parent questionnaire (they did not return the questionnaire even after sending them two reminders) was more frequent as is often the case but is not described further as is not central to the analyses presented.

Comparability of the 2 Intervention Conditions at Pre-test

To ensure that the process of randomisation to treatment condition had been successful in eliminating pre-test imbalance in main outcomes and to control for extraneous variables (e.g., socioeconomic status indexed by parents' education and occupation), comparisons were first undertaken on relevant pre-test measures. These are reported in Table 1. Inspection of Table 1 shows that the two intervention conditions in the sample were matched on pre-test reading and on a range of extraneous variables (i.e., chronological age, gender, parents' education, and occupation). Formal statistical testing assumed a conservative alpha ($p < .01$) to control for multiple tests and confirmed there were no significant pre-test differences. Across conditions, inspection of means of standard scores clearly shows a large sample here with below average word reading (both conditions more than 1 standard deviation below expected averages of 100), alongside wider verbal ability and intellectual ability standard scores in the low to mid 90s that approach typicality. It is reasonable to assume that our sample, as a whole, had *specific* reading

difficulties. These go hand in hand with poor phonological awareness (for comparison, the mean scaled score on the CTOPP phoneme elision task in a typical reader population = 10, *SD* = 3)

Table 1.2

Characteristics of the Intervention Sample by Condition

Condition	S*f*V	Morph	*F* value and significance
Gender (*n* = female) [b]	92	72	3.40 *ns*
Chronological Age yr month (range) [b]	7:60 (2:8)	7:70 (3:4)	1.04 *ns*
Parent-reported LD [b]	13	12	.14 *ns*
Mother's education [b]	2.97	3.21	1.89 *ns*
Father's education [b]	2.72	2.91	1.05 *ns*
Mother's occupation [b]	4.05	4.69	1.88 *ns*
Father's occupation [b]	4.90	5.11	.30 *ns*
English as part of home language [b]	111	113	.05 *ns*
WIAT Word Reading [a]	78.86 (8.19)	79.23 (8.36)	.06 *ns*
WIAT Vocabulary [a]	95.18 (15.88)	94.76 (15.44)	.17 *ns*
CAS Matrices [a]	94.07 (10.88)	91.23 (12.45)	5.16 *ns*
Elision [d]	7.51 (1.89)	7.53 (2.10)	.02 *ns*

Note: S*f*V = Set for Variability; Morph = Morphology; LD = Learning Disabilities; WIAT = Wechsler Individual Achievement Test; CAS = Cognitive Ability System. Mother's and father's education was measured on a 7-point scale (1 = finished elementary school, 2 = did not receive school graduate diploma, 3 = left school with graduation diploma, 4 = received technical training, 5 = finished college, 6 = university bachelor's degree, and 7 = completed graduate studies). Mother's and father's occupation was coded using the 9-point scale in the International Standard Classification of Occupation (International Labour Office, 2012). The scores were then reversed to be on the same scale as parents' education. ANOVA was used to test for group differences in continuous variables and chi square for group differences in frequencies. Values represented by (a) standard scores, (b) raw scores, (c) median, (d) scaled scores.

Hierarchical Model Building

The hierarchical or multi-level (MLM) models likely appropriate to this data require stepwise construction and verification prior to running. Educational data is often 'hierarchical' with children nested in classrooms that are nested in schools. In each case, the nesting (clustering) of scores violates the assumption of statistical independence of each data point in standard Ordinary Least Squares (OLS) models. Preliminary 'unconditional models' of raw score attainment data using classroom level indices of clustering were thus first run to assess nestedness. These analyses showed that there was a high level of shared classroom-level variance (i.e., substantial 'nestedness' of scores in classrooms), such that MLM modelling was appropriate (Hayes, 2006; Hox, 2010). These were: 46.30% in WIAT word reading; 11.70% in WIAT vocab; 24.00% in CTOPP phoneme elision; 18.69% MA inflected analogies; 30.29% in MA derivational analogies; 36.82% in Intervention regular words; 39.32% in Intervention irregular words; 22.67% in Intervention nonwords; 44.15% in S*f*V word reading; 36.52% in CC3 regular words; 42.43% in CC3 irregular words; and 28.48% in CC3 nonwords.

We also used INTERVENTIONISTID (the unit of interventionist as opposed to regular classroom) as a second measure of nested variance instead of classroom. These analyses generally produced somewhat smaller, but still substantial estimates of shared variance: 28.24 % in WIAT word reading; 9.74% in WIAT vocab; 20.87% in CTOPP phoneme elision; 10.04% MA inflected analogies; 16.63% in MA derivational analogies; 26.97% in Intervention regular words; 28.45% in Intervention irregular words; 12.22% in Intervention nonwords; 26.95% in S*f*V word reading; 22.93% in CC3 regular words; 27.97% in CC3 irregular words; and 19.30% in CC3 nonwords.

Subsequently, ‘grand-mean’ centered classroom level variables for all pre-test attainment predictors were created. These variables code the underlying ‘nestedness’ at the classroom level in our analyses. It was assumed that school-level randomization to treatment condition and large sample size largely negated additional school-level effects of nesting on outcomes. ‘Grand mean centering’ also aids in controlling for collinearity in analyses (a common problem of overspecification in statistical regression modelling that can otherwise adversely affect analyses) and additionally aids the interpretation of resultant coefficients in main analyses.

To assess repeated measures of time of assessment (pre-test, post-test and delayed post-test), we created a ‘stacked’ longitudinal data set using the procedures and syntax described by Peugh and Enders (2005). Such ‘repeated measures’ (a form of longitudinal growth curve model) accurately codes the statistical variance associated with repeated assessment of each child’s attainment over time. In their purest form, repeated measures models assume equal temporal distances at the formal pre-test, post-test, and delayed post-test phases of data collection between each child’s assessment. As this very high degree of temporal precision is unlikely to be achievable in very large multivariate intervention designs such as this one here, we first formally assessed this assumption of temporal structure. Following procedures described by Singer and Willett (2003, pp. 144-145), we first evaluated candidate ‘structure-constrained’ ‘Wave’ (pre-test vs. post-test vs. delayed post-test) - defined models versus ‘unstructured’ (purely chronological age-defined) longitudinal growth models. Inspection of resultant variance models and model-fit statistics, Deviance -2LogLikelehood (2LL), Akaike’s Information Criteria (AIC), Hurvich and Tsai’s Criterion (AICC), and Schwarz’s Bayesian Criterion (BIC) all showed better model fit with Wave over Chronological Age modelling of temporal data features. We thus used a structured (Wave-based) model for all analyses and centered all level 1 attainment scores at

times 1-3 (pre-test post-test and delayed post-test) to the corresponding mean of the pre-test scores.

Multilevel Linear Analyses

We undertook longitudinal MLM using the raw (not age-standardized) attainment test scores. We modeled Fixed effects of intervention 'Condition:' (phonics + Set for Variability vs. Phonics + Morphology) over time with Repeated Measures on 'Wave':(pre-test, post-test, and delayed post-test) as well as the Condition X Wave interaction effect. Corresponding pre-test nested attainment (e.g., grand-mean centered classroom-average WIAT word reading measures for WIAT WORD reading Wave outcome measures) was entered to assess and control for data nestedness in all analyses. We subsequently entered a variable coding intervention 'dosage' (the number of lessons each child received at 'level 1' – the student level) as an index of 'dosage' and observed in subsequent models. Our base statistical model is formally described by the following pair of statistical equations:

$$\text{Level 1:} \quad Y_{ij} = \beta_{0j} + \beta_{1j}\,(\text{CONDITION}) + \beta_{2j}\,(\text{WAVE x CONDITION}) + e_{ij}$$

$$\text{Level 2:} \quad \beta_{0j} = \gamma_{00} + \gamma_{01}\,(\text{PRETEST CLASSMEAN}_j) + r_{0j}$$

Equations at Level 1 (individual student) and Level 2 (nested classrooms) describe this analytic model at the student and classroom levels for student *i* in classroom *j*, respectively.

Results of these analyses are reported in Table 2. Results showed that the nested pre-test control variable for each analysis was always a significant predictor of attainment. MLM run as here within IBM analysis frameworks zero-codes the second intervention (here morphology) as a baseline and then zero-references the first intervention (here, Set for Variability) to assess the potential differential effects of the two conditions.

Table 2.2

Means, Standard Deviations, and Effect Sizes for Pre-Test, Post-Test, and Delayed Post-Test Literacy Measures by Intervention Group

	Phonics + S*f*V			Phonics + Morphology			Phonics+S*f*V Effect Size		Phonics+Morphology Effect Size	
	T1	T2	T3	T1	T2	T3	T1-T2	T1-T3	T1-T2	T1-T3
WR[a]	78.86 (8.19)	86.38 (10.43)	87.83 (10.82)	79.23 (8.36)	86.85 (9.39)	88.80 (10.31)	0.96	1.09	0.92	1.16
RV[a]	95.18 (15.88)	99.83 (15.45)	102.14 (15.98)	94.76 (15.44)	98.94 (14.18)	100.98 (14.28)	0.30	0.45	0.27	0.40
CC3R[b]	11.27 (9.35)	20.40 (9.60)	23.54 (9.86)	10.93 (8.06)	21.19 (9.00)	23.92 (8.67)	1.05	1.41	1.18	1.49
CC3E[b]	6.81 (5.63)	10.63 (5.62)	12.39 (5.91)	6.21 (4.79)	10.54 (5.14)	12.63 (4.88)	0.73	1.07	0.83	1.23
CC3N[b]	5.29 (5.99)	13.39 (9.61)	14.51 (9.52)	5.97 (5.87)	12.81 (9.91)	15.93 (10.29)	1.37	1.55	1.15	1.68
S*f*V[b]	4.87 (4.33)	8.69 (4.51)	9.98 (4.70)	4.65 (4.16)	8.62 (4.32)	10.07 (4.30)	0.90	1.21	0.94	1.28
PhonE[a]	7.51 (1.89)	8.73 (2.55)	9.24 (3.03)	7.53 (2.10)	9.04 (3.01)	9.27 (2.86)	0.61	0.87	0.76	0.87
MAI[b]	1.72 (2.11)	3.19 (2.40)	4.01 (2.58)	1.53 (1.91)	3.14 (2.51)	4.04 (2.69)	0.73	1.14	0.80	1.25

MAD[b]	2.53 (2.25)	4.06 (2.12)	4.84 (1.90)	2.40 (2.30)	4.06 (2.05)	4.75 (1.74)	0.67	1.02	0.73	1.04
INTRR[b]	5.94 (3.64)	9.70 (3.06)	10.10 (2.74)	5.92 (3.02)	9.72 (2.95)	10.23 (2.28)	1.12	1.24	1.13	1.29
INTIR[b]	5.98 (3.84)	9.98 (2.82)	10.38 (2.53)	6.07 (3.38)	9.99 (2.47)	10.50 (2.01)	1.04	1.22	1.08	1.22
INTNR[b]	3.61 (2.84)	6.71 (3.44)	7.33 (3.06)	3.75 (2.61)	6.95 (3.32)	7.25 (3.08)	1.14	1.36	1.17	1.29

Note: T1 = Pre-test; T2 = Post-test; T3 = Delayed Post-test; WR = Word Reading (WIAT); RV = WIAT Receptive vocabulary; CC3R = Castles & Coltheart regular words; CC3E = Castles & Coltheart irregular words; CC3N = Castles & Coltheart nonwords; SfV = Set for Variability; Morphology = morphology intervention; PhonE = CTOPP Phoneme elision; MAI = Morphological awareness inflectional analogies; MAD = Morphological awareness derivational analogies; INTRR = Intervention regular word reading; INTIR = Intervention regular word reading; INTNR = Intervention nonword reading. Values are represented by (a) standard scores, (b) raw scores, and (c) medians.

Results of MLM depicted in Table 3 also showed that there was no main effect of Intervention Condition on any outcome measures, showing no differential effects of either intervention. There was, however, a significant interaction effect of Wave x Intervention Condition for both intervention conditions for all seven outcome measures reported, showing that there was a significant change in attainment between pre- and post-tests in both interventions. Upper and lower 95% confidence intervals around these estimates of change over time were both well above zero for both interventions in all analyses, showing that we can have high confidence that the positive findings reported here for intervention were not due to chance.

Subsequent analyses adding variables further improved all indices of overall model-fit in all analyses reported (Deviance -2LogLikelehood, (2LL), Akaike's Information Criteria (AIC), Hurvich and Tsai's Criterion (AICC) and Schwarz's Bayesian Criterion (BIC). Results reported in Table 3 showed that there was a strong main effect of number of lessons delivered (i.e., dosage) on growth in attainment for WIAT word reading, but not for CC3 regular, irregular, and nonword reading, or other outcome measures. There was no significant difference between Intervention Conditions overall on the number of lessons received ($F < 1$).

Table 3.2

MLM Results by Intervention on Primary Post-Test Attainment Measures with Dosage Moderator

	Student-Level Model		Classroom-Level Model	
Variable	Coefficient	SE	Coefficient	SE
1. DV = WIAT Word Reading				
Intercept	3.19	1.17**		
Dosage	0.50	0.15***		
Intervention Condition				
Set-for-Variability	0.46	1.65		
Morphology	0	0		
Intervention Condition x Wave				
Set-for-Variability	2.88	0.40**		
Morphology	3.22	0.41*		
Intervention Condition x Dosage				
Set-for-Variability	-0.11	0.06		
Morphology	-0.07	0.06		
WIAT Word Reading Classroom mean pre-test			0.90	0.07***
Variance Components				
Child	50.48	4.45***		
Residual	13.66	1.05***		
2. DV = CC3 Regular word reading				
Intercept	-5.24	0.77***		
Dosage	0.11	0.10		
Intervention Condition				

Set-for-Variability	0.24	1.09		
Morphology	0	0		
Intervention Condition x Wave				
Set-for-Variability	5.36	2.48*		
Morphology	5.59	2.40*		
Intervention Condition x Dosage				
Set-for-Variability	-0.02	0.05		
Morphology	-0.02	0.05		
CC3 Regular word reading mean pre-test			0.78	0.06***
Variance Components				
Child	29.41	3.09***		
Residual	30.04	1.63***		
3. DV = CC3 Irregular word reading				
Intercept	-2.81	0.39***		
Dosage	0.06	0.05		
Intervention Condition				
Set-for-Variability	0.47	0.55		
Morphology	0	0		
Intervention Condition x Wave				
Set-for-Variability	2.81	0.14***		
Morphology	3.23	0.14***		
Intervention Condition x Dosage				
Set-for-Variability	-0.01	0. 02		
Morphology	0.03	0.02		
CC3 Irregular word reading mean pre-test			0.87	0.05***
Variance Components				

Child	10.42	0.98***		
Residual	6.62	0.36***		
4. DV = CC3 Pseudoword reading				
Intercept	-4.34	0.80***		
Dosage	0.05	0.10		
Intervention Condition				
Set-for-Variability	0.90	1.13		
Morphology	0	0		
Intervention Condition x Wave				
Set-for-Variability	4.63	0.32***		
Morphology	5.00	0.32***		
Intervention Condition x Dosage				
Set-for-Variability	0.01	0. 05		
Morphology	0.02	0.05		
CC3 Pseudoword reading mean pre-test			0.95	0.09***
Variance Components				
Child	33.91	1.85***		
Residual	28.02	3.09***		
5. DV = Set-for-Variability				
Intercept	-2.30	0.34***		
Dosage	-0.01	0.04		
Intervention Condition				
Set-for-Variability	0.20	0.48		
Morphology	0	0		
Intervention Condition x Wave				

Set-for-Variability	2.57	0.13***		
Morphology	2.72	0.13***		
Intervention Condition x Dosage				
Set-for-Variability	-0.01	0.02		
Morphology	0.02	0.02		
Set-for-Variability mean pre-test			0.89	0.59***
Variance Components				
Child	6.53	0.65***		
Residual	5.39	0.29***		
6. DV = Morphological Inflection				
Intercept	-1.15	0.23***		
Dosage	0.18	0.03		
Intervention Condition				
Set-for-Variability	0.15	0.33		
Morphology	0	0		
Intervention Condition x Wave				
Set-for-Variability	1.15	0.10***		
Morphology	1.26	0.10***		
Intervention Condition x Dosage				
Set-for-Variability	0.01	0.02		
Morphology	-0.01	0.01		
Intervention Condition x Intervention quality				
Morphological Inference mean pre-test			0.77	0.07***
Variance Components				
Child	1.40	0.20***		
Residual	3.29	0.18***		

7. DV = Morphological Derivation				
Intercept	-1.00	0.19***		
Dosage	0.02	0.03		
Intervention Condition				
Set-for-Variability	0.05	0.28		
Morphology	0	0		
Intervention Condition x Wave				
Set-for-Variability	1.14	0.08***		
Morphology	1.16	0.09***		
Intervention Condition x Dosage				
Set-for-Variability	0.01	0.01		
Morphology	0.00	0.01		
Morphological Inference mean pre-test			0.60	0.05***
Variance Components				
Child	0.93	0.14***		
Residual	2.41	0.13***		

Note. DV = Dependent Variable; MLM = Multilevel hierarchical linear modeling; WIAT = Weschler Individual Achievement Test. *** $p < .001$, ** $p < .01$, * $p < .05$.

Discussion

The purpose of this study was to examine the effects of two theory-driven interventions in a large group of Grade 2 and 3 struggling readers during the COVID-19 pandemic. Interventions shared a focus on systematic phonics and shared book reading, but differed in the way irregular words were taught (i.e., either through mispronunciation correction or through morphology). Before we discuss the results of the intervention, it is important to note that we observed high classroom-level variance in all outcome measures (the highest being 46.30% in WIAT word reading); meaning that children's reading performance was partly explained by differences between classrooms. Even though some classroom-level variance was expected on the basis of the findings of previous studies (e.g., Chen & Savage, 2014; Savage et al., 2018; 2020; Torgesen et al., 2001), the size of the classroom-level variance observed here was very high. This is probably reflecting the fact that reading instruction varied widely during the COVID-19 pandemic even within the same school (i.e., some teachers were providing reading instruction online every day, others a few times a week, and others once a week; see Dunn et al., 2023).

The results of Table 1 also show that our sample consisted of below average readers at pre-test. Across conditions, the mean of standard scores showed below average word reading performance (both conditions more than 1 standard deviation below expected averages of 100), and verbal ability and nonverbal cognitive ability standard scores in the low to mid 90s that approach typicality. The word reading difficulties also went hand in hand with poor phonological awareness (as measured by the CTOPP phoneme elision task), a finding that has been well documented in the literature (e.g., Hulme et al., 2012; Melby-Lervåg et al., 2012; Savage et al., 2018. On the basis of the above, it is reasonable to assume that our sample as a whole had a

profile consistent with that of children with specific word reading difficulties, when assessed at pre-test.

In regard to the main purpose of our study, our results showed significant improvement on all measures in both reading interventions from pre-test to post-test and delayed post-test (see Table 2). The average scores in WIAT word reading following the intervention show that the scores did not reach average for the whole sample (i.e., average standard word reading scores are not 100), but suggest strong improvements had been made over the time period covered. Notably, these positive effects were sustained at delayed post-test, and if anything, there was modest growth (not 'fade') in effects from post-test to delayed post-test. Effect sizes (measures of practical significance) of results were three times larger than those reported for reading intervention studies in early grades in recent meta-analyses (e.g., Gersten et al., 2020; Waznek et al., 2018). There might be two explanations for this: First, both intervention conditions combined instruction in the foundational skills of word recognition (i.e., phonological awareness and phonics) and this may have led to higher effect sizes than interventions targeting either phonological awareness or phonics. Our choice of including instruction in phonological awareness was intentional because previous studies have shown that children with better phonological awareness are better prepared to receive phonics instruction (e.g., Foorman et al., 1997; Savage et al., 2020). Second, when we screened children for reading difficulties in September 2021, this occurred after a school year (2020-2021) characterized by increased transitions from in person to online instruction and absenteeism for both teachers and students. This meant that our sample also included children who simply missed out on instruction and did not have severe deficits in underlying cognitive-linguistic skills that typically hinder reading acquisition and response to intervention. When these children received appropriate instruction,

they improved much more than what would be expected if our sample had consisted only of children who were struggling readers because of underlying cognitive-linguistic deficits.

The intervention effect sizes were broadly equal (comparably large) in the two intervention conditions (see Table 2). This finding was a bit surprising given that we would expect the Phonics + Set for Variability intervention to produce stronger effects on Tunmer and Chapman's (2012) Set for Variability word reading task and the Phonics + Morphology intervention to produce stronger effects on the morphological awareness tasks. We speculate that the time allotted for training in mispronunciation correction or in morphology was relatively short (i.e., 5 minutes) compared to the rest of the intervention elements and this did not allow for any differences between conditions to emerge. This finding was in contrast to Dyson et al. (2017) who found strong effects of teaching Mispronunciation Correction (i.e., S*f*V) on reading irregular words in a trained set (d = .95) and evidence of generalization to reading matched untaught words (d = .23) in 84 children (ages 5 to 7 years old). Dyson's et al. (2017) study was conducted in small groups of up with up to eight children in two 20-min sessions per week for 4 weeks. Each week, one group of five irregular words were taught.

The formal statistical significance of the intervention effects is confirmed in the results reported in Table 3. Inspection of these results shows that there was a significant interaction between wave and both intervention conditions, showing significant growth in reading over time, after controlling for the strong effects of data nestedness. This exact same pattern of significant (Wave, equally for both intervention conditions) and nonsignificant (Condition) effects played out across all seven primary outcome variables reported in Table 3. These primary results (all significant at $p < .001$) remained significant after controlling for multiple alpha testing (i.e., .05/7 = .003).

Finally, the number of lessons received by each child (i.e., dosage) was a significant predictor of growth in WIAT word reading across both interventions but was a nonsignificant predictor in all other outcome measures. Notably, adding "dosage" into the equation improved the overall model fit statistics for all outcome measures even if not significant, which suggests the training and additional support we offered to interventionists throughout the intervention mattered. There was no evidence of differential mediation of effects across the two intervention conditions (Set for Variability and Morphology) by the number of intervention sessions received in any analysis. The average number of lessons received per child was 52.06 (*SD* = 5.46) out of a maximum of 60, so most schools delivered a high 'dosage' of interventions, potentially reducing the effects of dosage. These results suggest high intervention compliance. These findings are in line with previous RCT studies with struggling readers (e.g., Christodoulou et al., 2017; Gunn et al., 2005; Lovett et al., 2017) that have found medium to large effect sizes on word reading when dosage is greater than 50 lessons. The findings of reading interventions conducted with struggling readers during COVID-19 were mixed. Cadime et al., (2022), for example, found a large effect in word reading (*d* = 1.152) with only 27, 40-minute sessions and Cancer et al. (2021) found a small effect in word reading accuracy with a dosage of 39 sessions (15 minutes each time).

Implications for Practice

We delivered intervention to a large group of struggling readers across multiple schools via teachers trained by university partners through professional development (PD) on theory-driven instruction shown to be effective in wider research. Such PD and teacher training and delivery via university-school board partnership was demonstrably effective in raising reading attainment of struggling readers. The approach used here was also an 'Intention-to-Treat' (ITT)

design and analysis, in that there were no formal exclusions of any participant (unless they had average reading and/or severe intellectual or sensory difficulties). Given the same ITT logic, we also did not exclude any schools or interventionists, even where number of lessons or observed lesson quality was below where we might hope to see it. Such ITT approaches thus speak to policy and wider roll-out as they reflect the complexity of large diverse 'real world' samples, and the likely impact in such wider 'real world' contexts of replication and extension of training and delivery models used here. Given the clear evidence of effectiveness wider roll-out of the model might now be considered.

Results on the norm-referenced WIAT word reading task further suggest that it is important to deliver all 60 intervention lessons to achieve the full effect in either intervention, so schools should be encouraged to do this in the future. Hall et al. (2022) found that higher dosage interventions, on average, yielded slightly larger effect sizes than lower dosage interventions by 0.002 (p = .040). A very small minority of interventionists delivered lower quality teaching interventions. These might usefully be the focus of additional PD support for maximal impact. The fact that a vast majority of the lessons were well-implemented, however, suggests that the professional training model was appropriate for the study purpose and was well-implemented.

Limitations

Some limitations of the present study should be considered First, because of the urgency to address possible learning losses due to COVID-19, the participating school divisions did not allow us to also include a "Business-As-Usual" (BAU) group that would not get any intervention. Even though we did not have a BAU group, the fact that we included a second intervention group that was matched to the experimental group on several extraneous variables

and that we also administered some norm-referenced assessments (i.e., WIAT word reading and vocabulary, CTOPP Phoneme Elision) gives us some confidence that the observed effects of the intervention are "true" effects and not simply the result of maturation. Second, because not all school divisions in this study had been using norm-referenced assessments to monitor their students' reading performance, it was not possible for us to identify the children in our sample who were struggling in reading even before the pandemic. Thus, we do not know if our intervention had a differential effect on these children. Finally, even though the two intervention conditions differed in how irregular words were supposed to be taught, this difference was not large enough to produce meaningful differences in the outcome measures. Because we did not develop a task that directly measured multimorphemic words, it is possible that there was less opportunity for the participants in Condition 2 to prove their knowledge.

Conclusion

Our findings add to a growing body of interventions aiming to address possible learning losses due to COVID-19 (e.g., Cadime et al., 2022; Sucena et al., 2022) by showing that explicit, systematic and intensive instruction can improve the reading performance of struggling readers even during a pandemic. Notably, the effect sizes of our intervention were three times larger than the average effect sizes reported in recent meta-analyses (e.g., Gersten et al., 2020; Waznek et al., 2018) suggesting that when intervention is delivered with fidelity and school divisions invest in training their teacher interventionists, we have very good chances to reduce reading difficulties.

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Chapter 4: General Discussion

This present dissertation focused on different home and school interventions that aided at-risk students' reading performance during the COVID-19 pandemic. First, the findings of this dissertation are summarized. Second, the main results are discussed with respect to previous literature and educational implications are presented.

Summary and Review

Based on previous studies that explored the home literacy environment and reading, as well as reading interventions conducted during the COVID-19 pandemic, two studies were developed to examine whether the effects of home and school interventions aided at-risk students' reading performance during the COVID-19 pandemic. The studies included English-speaking struggling readers from Grade 1 (Study 1) and Grade 2 and 3 (Study 2) attending public elementary schools in Alberta, Canada.

Intervention Outcomes

The first study (Chapter 2) examined whether different parent- and teacher-related factors had an effect on at-risk Grade 1 children's reading performance during the COVID-19 school closures. Among the parent-related factors, children's reading enjoyment and home learning activities were significant predictors of word reading and pseudoword reading. This result was in line with previous studies that found reading interest was predictive of early literacy skills (e.g., Carroll et al., 2019; Hume et al., 2016). For example, Georgiou et al. (2021) suggested that reading interest was important early on for children to develop adequate decoding skills and for becoming an independent reader earlier. However, it was suggested that after Grade 2 other factors beyond reading interest such as independent reading may also drive the relation of

reading skills (Silinskas et al., 2020). Among the teacher-related factors, only differentiation of instruction was a significant predictor of children's reading skills at Time 2 and only when predicting WIAT pseudoword decoding. The teachers who managed to differentiate their instruction amid the significant challenges of delivering instruction online had a stronger influence on children's decoding. The difference between teachers in their online and in-class teaching was reinforced by earlier findings in a similar classroom context by Parrila et al. (2022) who found teachers' ability to differentiate instruction was a significant predictor of their children's future decoding skills.

In Study 2, we aimed to improve the reading performance of struggling readers returning in September 2020 immediately after schools reopened. Specifically, we examined the effects of two theory-driven reading interventions (Phonics + Set for Variability and Phonics + Morphology). English is a morphophonemic orthography (Venezky, 1967) and teaching phonics plus morphology is a natural fit to the characteristics of the orthography. At the same time, English is thought to be an opaque orthography (Seymour et al., 2003) with a significant number of regular words that can be taught through phonics as well as irregular words that can be taught through mispronunciation correction (a strategy used in Set for Variability). Results of Study 2 showed significant improvements on all reading measures in both interventions from pre-test to post-test and delayed post-test with large effect sizes in all reading outcomes. For example, WIAT word reading scores showed the largest effect in both intervention conditions: Phonics + S*f*V (*ES* = 1.09) and Phonics + Morphology (*ES* = 1.16). Although the post-test and delayed post-test WIAT word reading scores did not reach average (i.e., average word reading standard scores were still not 100), they did suggest that strong improvements had been made over the time covered. There was no significant difference between the two intervention conditions.

Notably, the effect sizes were three times larger than those reported for reading intervention studies in early grades in recent meta-analyses (e.g., Gersten et al., 2020; Waznek et al., 2018). Our findings were in line with reading intervention studies conducted during the COVID-19 pandemic that found significant effects in word reading (e.g., Cadime et al., 2022; Cancer et al., 2021; Fuchs et al., 2023). For example, Cadime et al. (2022) found a large effect in word reading (d = 1.152) and Cancer et al. (2021) found a small effect in word reading accuracy with no significant differences between groups. However, both studies had a relatively small sample size, did not have a control group for comparison, and lacked a delayed post-test to measure if the effects of intervention maintained over time.

Both WIAT word reading, and word decoding showed significant large effects. These findings may be explained by both intervention conditions combined phonological awareness and phonics rather than targeting either phonological awareness or phonics. Previous studies have shown that children with better phonological awareness are better prepared to receive phonics instruction (e.g., Foorman et al., 1998; Savage et al., 2020). Our sample included children who missed instruction (due to the previous COVID-19 school year) and some had severe deficits as shown by their performance in phonological awareness. When these children received appropriate instruction, they improved more than what would be expected.

Differentiation of Instruction

An important feature of meeting the needs of the struggling readers was the teachers' ability to adapt instruction. In Study 1, Teachers who differentiated instruction had a relatively stronger impact on their students' word reading. Thus, WIAT pseudoword decoding at Time 2 was significantly higher among children whose teacher differentiated instruction than those who did not. This finding fits well with evidence presented by both Kiuru et al. (2015) and

Ruotsalainen et al. (2022) who suggested that Grade 1 teachers may be more knowledgeable of their students' reading performance and able to adapt their instructional practices for children who struggle. Second, it is possible that the differences in teachers' ability to differentiate instruction lied in their level of comfort with navigating online technology allowing them to focus exclusively on student learning. Finally, it is also possible that teachers felt a level of preparedness having received professional development prior to the pandemic on how to differentiate instruction.

To our surprise, teachers' self-efficacy (perceived ability) to teach struggling readers was not correlated with any of the students' reading outcomes in Study 1. However, both Study 1 and Study 2 showed significant effects on word reading and both studies included differentiated instruction to meet the needs of student learning. According to Bandura (1994) differentiated instruction involves a high level of teacher self-efficacy. A teachers' self-efficacy, their level of confidence in their ability to promote student learning, can be a significant motivator of children's academic growth. Thus, teachers with high self-efficacy tend to have high levels of planning and organizational skills and can differentiate pedagogy according to their students' learning needs. Moreover, teachers with high self-efficacy are better equipped to prioritize and assist students who need additional support (i.e., struggling readers) (e.g., Ashton & Webb 1986; Tschannen-Moran & Barr, 2004; Tschannen-Moran & McMaster, 2009).

Fortunately, the teachers who participated in both our studies received professional development on how to differentiate instruction and they were given access to materials that targeted phonemic awareness and phonics. According to Strickland et al. (2003), professional development can have a positive effect on the improvement of literacy instruction and reading achievement when teachers learn high quality instructional practices. However, the effect may

vary depending on the modality and intensity of professional development (Martinez et al., 2022). Although we did not measure teacher's perceived ability in Study 2, we did assess Treatment Integrity (TI) using an experimenter designed, 3-point TI rubric (adapted from Savage et al., 2018) to measure Quality of Instruction. A qualifying description for this category was differentiation of instruction. Two intervention sessions were independently observed confirming both intervention conditions were equally well implemented (98% inter-rater reliability). The fact that the vast majority of lessons in the intervention conditions were well-implemented may suggest that not only that our professional development training model was effective, but also that differentiation of instruction likely played an important role in implementation.

Intervention Variables

Not surprisingly, in both Study 1 and Study 2 we observed high classroom-levels of variance in all outcome measures, particularly in word reading. In Study 2, we observed the highest variance in WIAT word reading being 46.30%. Even though some variance was expected based on the findings of previous reading intervention studies before COVID-19 (e.g., Savage et al., 2018, 2020), this variance was widely found in other reading intervention studies during the pandemic (e.g., Cadime et al., 2022; Fuchs et al., 2023). Of the reading intervention studies conducted during COVID-19, only two included a control group (Fuchs et al., 2023; Tsesmeli & Skarmoutsou, 2023), two measured treatment fidelity (Beach et al., 2021; Fuchs et al., 2023), and no studies included a delayed post-test. Notably, it was common for all the studies to widely vary in the instructional focus, session duration, and method of delivery they used during the pandemic.

According to systematic and meta-analytic reviews of early reading intervention studies

(e.g., Gersten et al., 2020; Hall et al., 2022; Wanzek et al., 2016), a number of common variables contribute to quality intervention instruction. These variables include small group delivery to students with similar academic needs (2 to 5 maximum), sessions that include between 10 and 100 sessions of instruction, and lessons that have a duration of 20-40 minutes or 10-60 minutes (3 to 5 times a week). Noticeably, our reading intervention met all these features, and this may partly explain why the effect sizes were large. In addition, we feel that the literacy consultants in each school division (that were checking on the interventionists on a regular basis) helped maintain the quality of the intervention lessons and provided additional support for the interventionists.

In Study 2, the finding that dosage (i.e., average lessons taught in the intervention) led to significant effect of intervention from pre-test to post-test and delayed post-test was not surprising. The children in both intervention conditions received an average of 52.06 (*SD* = 5.46) lessons. Each lesson included explicit instruction in phonemic awareness (3 minutes) and phonics (10 minutes) that introduced a grapheme phoneme correspondence (GPC) and allowed the children to practice the GPC in the context of decoding regular words and shared book reading. The findings are in line with previous small-group reading intervention studies (e.g., Christodoulou et al., 2017; Gunn et al., 2005; Lovett et al., 2017) that have found medium to large effect sizes on word reading when dosage is greater than 50 lessons. In a recent systematic review and meta-analysis, Hall et al. (2022) found that increased dosage was associated with accelerated reading development when controlling for the effects of other moderators. Higher dosage interventions, on average, yielded slightly larger effect sizes than lower dosage interventions by 0.002 (p = .040). This finding provides more evidence to support recommendations for intensifying interventions by increasing dosage. This will help accelerate

gains for students who are at-risk for reading difficulties and have dyslexia. Furthermore, approximately two-thirds of the lesson time in both intervention conditions focused on phonics instruction. Previous studies have shown that teaching systematic phonics produces better results than alternative methods that do not target the grapheme phoneme correspondences (e.g., Ehri, 2001; Galuschka et al., 2014; McArthur et al., 2018; Slavin et al., 2011) and interventions that include systematic phonics instruction (e.g., Chen & Savage, 2014; de Graff et al., 2009; Savage et al., 2018, 2020).

In regards to irregular word reading, we expected that the Phonics + S*f*V intervention condition would have produced stronger effects on Tumner and Chapman's (2012) S*f*V word reading task, particularly since Savage et al. (2018) found significant advantages at post-test for Grade 1 and 2 children and Colenbrander et al. (2022) found that using S*f*V to train irregular words was effective compared to using other strategies of instruction. However, there was no significant difference between the two intervention conditions in irregular word reading. Comparably, our finding was in contrast to Dyson et al. (2017) who found strong effects of teaching mispronunciation correction (i.e., S*f*V) on reading irregular words in a trained set (d = .95) and evidence of generalization to reading matched untaught words (d = .23). Dyson et al. (2017) did not find, however, statistically significant effects of S*f*V on the test of Castles and Coltheart irregular word list (d = .12). These findings may be explained by differences in the complexity of the irregular words tested in the intervention. For example, the taught and untaught word lists were drawn from Tunmer and Chapman's (2012) list of irregular words and the Castles and Coltheart irregular word list contained words with a wider range of difficulty. Furthermore, Dyson et al. (2017) suggested that it was possible that the intervention was too brief with too low of intensity to produce significant results.

Whereas Dyson et al.'s (2017) study spent two 20-minute sessions per week teaching 5 target words using mispronunciation correction, Study 2 taught one to two irregular words per lesson in 5-minute sessions over 45 lessons. Similar to Dyson et al. (2017), it is possible the children in our intervention may have needed more time to work with the irregular words, especially at a higher frequency of application in a variety of contexts (e.g., practice games and shared book reading). Our future intervention studies will need to consider increasing the level of intensity dedicated to the explicit instruction and practice of irregular word decoding so that children can have better success with S*f*V to build their sight word vocabulary.

Limitations

Some limitations in the dissertation should be noted. In Study 1, due to the COVID-19 health restrictions in place, we were unable to visit houses to examine in vivo what parents were doing with their children. In turn, we opted to use a questionnaire to measure both parent- and teacher-related factors despite the risk of social desirability bias (i.e., parents responding based on what the society values and not based on what they actually did; Inoue et al., 2020; Manolitsis et al., 2011). Additionally, our parent questionnaires were relatively brief. Although this was intentional because it was likely that parents and teachers would have been less willing to fill out long surveys due to stress (Garbe et al., 2020; Jakubowski & Sitko-Dominik, 2021), we may have missed important information about the home environment, such as its contribution to code- versus meaning-related activities on children's reading performance. Unfortunately, we did not ask parents to indicate if they were experiencing any reading difficulties themselves. This is important because their own reading difficulties could influence the quality of assistance they could provide. According to Esmaeeli et al. (2017), parents who self-report reading difficulties should be advised about the important role the home literacy environment plays in the

development of their children's reading skills. Thus, they should be provided with guidance and resources in how to explicitly support their children's reading at home.

COVID-19 produced a wide variation in home situations. Another limitation in Study 1 that we did not include was an index of parents' work situations and its possible consequences on parenting. Studies during the pandemic showed that a number of factors significantly influenced family life. For example, the COVID-19 pandemic reduced salaries and increased job losses, and increased parental stress around health, transitioning to home-schooling and managing remote work (e.g., Chen et al., 2021; Westrupp et al. 2020). Finally, our sample consisted of predominantly White middle-class families, and as such, our findings may not generalize to other ethnicities and socioeconomic groups. Evidence from Kuhfeld et al. (2023) showed that COVID-19 had a greater impact on low-income families and Black or Indigenous children. These groups were either poorly or not at all represented in our sample.

In Study 2, similar to other reading intervention studies during COVID-19 (e.g., Fuchs et al., 2023; Tsesmeli & Skarmoutsou, 2023), our study did not have a control group. Although this was our intention, participating school divisions did not grant us permission to include one due to the urgency of addressing learning losses. To address the absence of a control group, we included a second intervention group that was matched to the experimental group on several extraneous variables and administered selected norm-referenced assessments (i.e., WIAT word reading and vocabulary, CTOPP Phoneme Elision), This gave us confidence that the observed effects of the intervention were "true" effects and not simply the result of maturation. Second, because not all school divisions in this study used norm-referenced assessments to screen reading performance, it was not possible for us to identify the children in our sample who were

struggling in reading before the pandemic. Thus, we do not know if our intervention had a differential effect on these children.

Conclusion and Future Implications

During the COVID-19 pandemic, students suffered significant learning losses due to reduced access to intensive instruction (e.g., Bao et al., 2020; Georgiou, 2021; Kuhfeld et al., 2023; Tomasik et al., 2021). As a result, countries from around the world have dedicated emergency funding for schools to provide immediate reading intervention (e.g., Chatzoglou et al., 2023). Taken together, Study 1 and Study 2 shed light on the importance of reading intervention during COVID-19 showing that both the home- and school- environment played important roles in improving early reading outcomes in struggling students. However, there is still a considerable amount of work to do to address learning loses (Bryant et al., 2023).

Children in Study 1 only received regular classroom instruction on average 1-2 times per week. As a result, 52.9% did not improve in their reading performance. In contrast, in Study 2, among the children who received pullout intervention, 80.4% showed improvement in their word reading from pre-test to post-test. This finding may indicate that whole classroom instruction does not necessarily help struggling readers who need more targeted, explicit intervention.

The findings of this dissertation added to the growing body of intervention research aiming to address learning losses due to COVID-19 (e.g., Cadime et al., 2022; Sucena et al., 2022). Notably, the effect sizes of our intervention were three times larger than the average effect sizes reported in previous meta-analyses (e.g., Gersten et al., 2020; Waznek et al., 2018) showing that explicit, systematic, and intensive instruction can improve the reading performance of struggling readers even during a pandemic. Given that about 20% of our participants did not

respond to the intervention, future studies should aim to intensify instruction and focus on maintaining strong fidelity. Future studies should also aim to include mixed methods approaches, such as interviews or focus groups to gather a more in-depth understanding of how teachers, parents, and students, can help inform the goals, feasibility, and effects of future reading intervention development. Importantly, future implementation of this intervention should be presented with a combined Response To Intervention (RTI) framework (Siegel, 2020). School divisions that invest in training their teachers in RTI can have a great overall impact on helping children become better readers and enjoy learning.

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Appendix A

CONDITION 1 – PHONICS + S*f*V LESSON SAMPLE

Lesson 8 – Understanding <e>, short /ĕ/

Objective: Students will identify and blend sounds to decode words that contain the target Grapheme Phoneme Correspondence (GPC).

Materials:

Letter-sound cards
Target word cards
Selected text for shared book reading
Letter-sound boxes (optional)
My Word Work recording sheet (optional)

Regular Words	**Irregular Words**
hen	some
pet	
sent	
stem	
best	
felt	

INSTRUCTIONS:

Briefly review GPC from previous lesson.

1. Phonemic Awareness Drill (3 minutes): manipulating the sounds you hear.

DO NOT SHOW THE CHILDREN THE WORDS!

Isolating beginning sounds: yuck chalk four kept

Say: *"I will say a word and you say it back to me. What is the first sound you hear in _____?" Response: yuck (student repeats yuck), sound /y/*

Isolating end sounds: ouch meet pride torn

Say: *"I will say a word and you say it back to me. What is the last sound you hear in _____?" Response: ouch (student repeats ouch), sound /ch/*

Isolating middle sounds: bet log tin wet

Say: *"I will say a word and you say it back to me. What is the middle sound you hear in_____?"*

Response: student repeats word then says sound. 'bet' /ĕ/, 'log' /ŏ/, 'tin' /ĭ/, 'wet', /ĕ/.

Blending Phonemes: pet bent dress nest

Say: *"I will say the sounds. What is the word?"*

Response: p-ĕ-t (pet), b-ĕ-n-t (bent), d-r-ĕ-s (dress), n-ĕ-s-t (nest).

Segmenting Phonemes: pest sent press pets

Say: *"I will say a word you will say it back to me. What are the sounds you hear in_____?"*

Response: pest (p-ĕ-s-t), sent (s-ĕ-n-t), press (p-r-ĕ-s), pets (p-ĕ-t-s)

2. Introduce the GPC of the day (10 minutes):

Show the students the letter-sound card e.

Say: *"This is the letter e. The letter e says /ĕ/. Say its sound with me: /ĕ…/."*

Show the students the target words.

Say: *"We can read words by sounding them out. Look at each word, listen to how I read them, then repeat after me."*

Show each target word one word at a time. Say the word aloud emphasizing the letter-sound /ĕ/. Have the students look at each word and repeat it back to you.

Regular Word Practice

Distribute one set of letter-sound cards to each student. Have the students lay the cards face up in front of them, then search for the letters h, e, n, p, and t. Tell them to place the rest of the letter-sound cards to the side.

Say: *"Let's blend these sounds together! Notice that there are three sounds. The short /ĕ/ sound will be in the middle of the word."*

Using the letters **h**, **e**, and **n**, model how to blend the sounds /h/, short /ĕ/ and /n/ together to decode the word *hen*. Place your finger under the 'h' letter- sound card as you say its sound: /h/. As you are saying its sound, move your finger to the next letter card and say its sound short /ĕ/ then to the last letter card /n/. Go back to the first letter and continuously blend the three sounds together /h-ĕ-n/ as you move from the first to the last sound /n/. Say the word (hen). Go back to the beginning and repeat the process again, continuously blend the first sound through to the last sound.

Say: *"Now it's your turn! Blend the sounds together."*

Have the students find the letter-sound cards p, e, and t. Using these letter- sound cards, ask them to say the sound of each letter, /p/-/ĕ/-/t/.

Say: *"Let's try reading another word."*

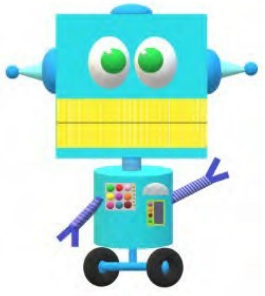
Watch and listen as the students blend. Model correct pronunciation and provide corrective feedback as needed. Have the students practice blending the same word multiple times, making sure they place and glide their finger under the letter-sound cards while blending aloud.

Repeat the continuous blending strategy to read other target words (sent, stem, best, and felt).

Modification: Provide the student with letter-sound boxes to help them visually organize the placement of letters and movement from the beginning to the end sound of the word.

Extension: For more-able readers, have them use the letter-sound cards to blend and read words on their own or with a partner. If the student is ready, they may write the letters as they blend them together to spell the word.

3. Irregular Word Practice (5 minutes):



Introduce irregular words of the day: some

Sparky the Robot puppet can be used to read along with the students.

Say: *"Let's sound out this irregular word - 'some'"*

(Sound out the word as it is spelled. e.g., "s-ō-m", pronounce the "o" as a long /ō/).

Since this is an irregular word, we need to go through several steps to be able to work out how to read it, because it does not sound like a word we know when we sound it out.

Show children the poster for reading and correcting the mispronunciation of words to help them learn and remember the steps of reading an irregular word.

Reading and Correcting the Mispronunciation of Words

As you describe each step, point to the corresponding step on the poster provided.

Say*: Step 1* *"Let's practice! The first thing we do is use our phonic rules and sound out the word." Show them the irregular word again. "Sound out this word." Point to each GPC as students sound out the word as 's-ō-m' with a long /ō/.*

Say: *Step 2* *"Next, we ask ourselves if this is a word we know. Is 's-ō-m' a word we know?" (Answer: No)*

Say: *Step* 3 "'S-ō-m' is not a word we know. Can we swap another sound we know for a letter or a few of the letters?" (e.g., swapping long /ō/ for short /ŭ/ in "come") "We can also ask ourselves if there is a word we know that sounds like the word we are reading. Is there a word we know that sounds like 's-ō-m'?" If the answer is "yes--some", skip to step 5the answer is "no", then go to step 4.

Say: *Step 4* *"If the word is very tricky, we may need more information to work it out. I will use the word in a sentence for you." Read the sentence aloud pronouncing the word as it is sounded out (e.g., Would you like "s-ō-m" cake?). "Does the word make sense in the sentence?" (Answer: "no") "Is there another word that sounds similar and makes sense in the sentence?" (Answer: "yes— some")*

Say: *Step 5* *"What word is this?" (Answer: "some") "What part of the word sounds different when we read it than when we sound it out?" (Answer: the letter "o") "We now know that the 'o' makes this an irregular word. The last thing we do is sound out and say the word, then write it down." (Students sound out the word as "s-ō-m", then say it as "s-ŭ-m", then write it down.)*

Say: *Pronunciation Practice* *"Can you tell the difference between how the word sounds when we sound it out compared to when we read it? Let's say it both ways and think about how you move your mouth." Students slowly pronounce the word both ways. As it is sounded out, "s-ō-m" and how it is read, "s-ŭ-m". "We move our mouth differently to change the sound of the word."*

Say: Review *"Let's look at the word one more time. What word is this?" (Answer: "some")*

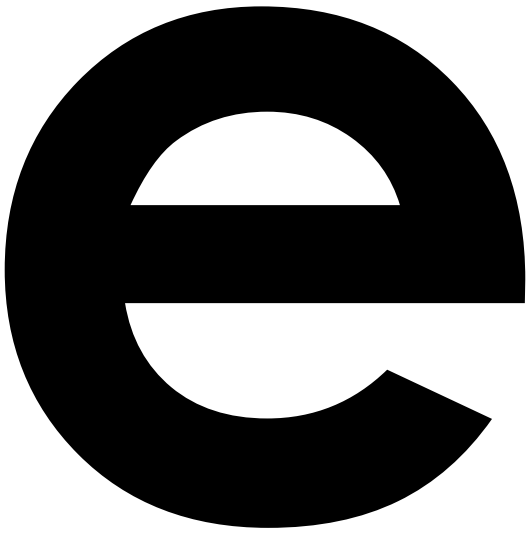
4. Shared Book Reading (10 minutes):

Using the text that you have selected for shared book reading, interactively read the text aloud, pausing at different places to help the students identify and read words that contain the letter-sounds. The students should be encouraged to read words they already know or learned in the lesson.

5. Wrap Up (2 minutes):

Ask the students to say the letter-sound of the lesson and read the irregular word they learned.

Lesson 8 – Letter-Sound Card <e>, short /ĕ/



Lesson 8 – Regular Word Cards <e>, short /ĕ

hen	pet
sent	felt
stem	best

Lesson 8 – Irregular Word Card <e>, short /ĕ/

some

Lesson 8 – Letter-Sound Cards <e>, short /ĕ/

h	e	n
s	t	m
p	l	b
f		

Mispronunciation Correction

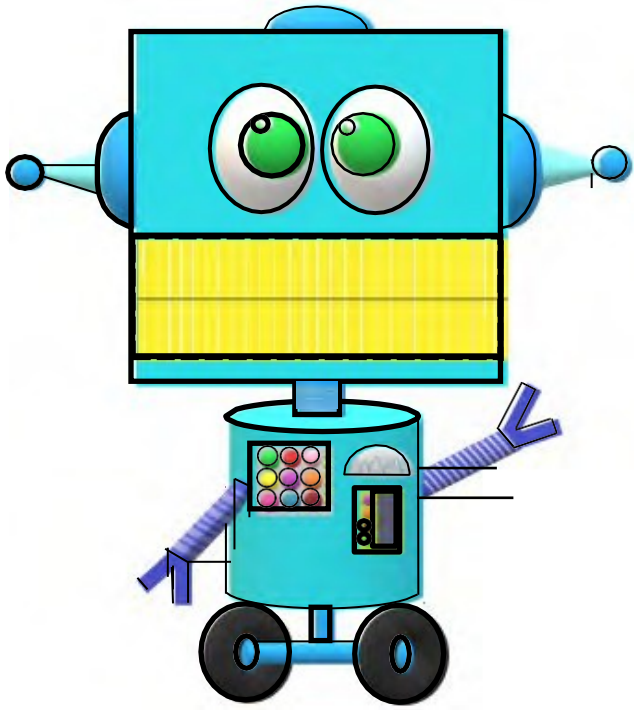
1. Sound out the word by blending the sounds together.

2. Ask yourself, is this a word I know?

3. If it is not, try swapping one or a few of the sounds for different sounds, or try to think of a word you do know that sounds the same.

4. If it's still not a word you know, read it in a sentence for more information to see if you know a similar sounding word that makes sense in the sentence.

5. You sound out the word, say the word, and write it down.



Appendix B

CONDITION 1 - PHONICS + S*f*V REVIEW LESSON SAMPLE

Review 3: Lesson 7-9 (<c> /k/, short <e> /ĕ/, <g> /g/)

Objective: Students will review decoding words that contain the learned Grapheme Phoneme Correspondences (GPCs).

Materials:

Letter-sound cards
Target word cards
Selected text for shared book reading
Letter-sound boxes (optional)
Real or Not Real recording sheet (optional)

Before beginning the lesson, select target words from the previous lessons that need to be reviewed. These words should include target words that have yet to be mastered and all the irregular words.

INSTRUCTIONS:

1. Review the letter-sounds, target, and irregular words (3 minutes)

First, show the students the individual letter-sound correspondence cards and ask them to tell you the name of each letter and the sound it makes (e.g., short e says /ĕ/). Next, select a number of target words from the previous lessons. Place one word in front of each student and ask them to blend the sounds together to read the word. Repeat with more words. These may be target words that were not decoded in the previous lessons or challenge words. Differentiate depending on the student's level. Finally, present the irregular words previously covered and ask the students to read them. Mix up the cards and repeat.

2. Word Work – How many words can you make? (7 minutes)

Provide each student with a supply of individual letter-sound cards. Pre-select how many and what letters to give to each student (e.g., begin with 3 letter cards and increase to make more words).

Say: *"How many words can you make? Look at the letters in front of you to blend and read words. The words can be real or non-words. Remember words must have both a consonant and a vowel."*

Review what a consonant and vowel is, if needed. You may also need to demonstrate how to arrange the individual letter-sound cards to make a V-C, C-V, and/or C-V-C word. Optional: students may keep a tally and record the number of real and non-words they make (see Real or Not Real recording sheet in lesson book).

Additional or Alternative Activity – Spell It! Read It!

Say: *"How many words can you spell and read? Look at your letters." (Dictate a word to the students.) "Spell the word _____. First, find the letters that make each sound. Next, put the sounds in order. Finally, blend the sounds together and read the word."*

Have the students write the word they spell on their whiteboard or on a Word Work recording sheet. Repeat with other words.

Modification: Provide the students with letter-sound boxes to help them visually organize the placement of letters and movement from the beginning to the end sound of the word.

Extension: For more-able readers, they may read and spell challenge words.

3. Shared Book Reading (10 minutes):

Using the text that you have selected for shared book reading, interactively read the text aloud, pausing at different places to help the students identify and read words that contain the letter-sounds. The students should be encouraged to read words they already know or have reviewed in the lesson.

Appendix C

CONDITION 2 – PHONICS + MORPHOLOGY SAMPLE LESSON

Lesson 30 – Understanding <a_e>, <long ā>

Objective: Students will identify and blend sounds to decode words that contain the target Grapheme Phoneme Correspondence (GPC).

Materials:

Letter-sound cards
Target word cards
Selected text for shared book reading
Letter-sound boxes (optional)
My Word Work recording sheet (optional)

Regular Words	**Irregular Words**
made	large
came	
lame	
same	
snake	
shape	

Instructions:

Briefly review GPC from previous lesson.

1. Phonemic Awareness Drill (3 minutes): manipulating the sounds you hear.

DO NOT SHOW THE CHILDREN THE WORDS!

Isolating middle sounds: lake tan get late

Say: *"I will say a word and you say it back to me. What is the middle sound youhear in__?"*
Response: lake (student repeats lake), sound /ā/

Blending Phonemes: make tale went name

Say: *"I will say the sounds. What is the word?" Response: m-ā-k_____(make)*

Segmenting Phonemes: make tale went name

Say*: "I will say a word you will say it back to me. What are the sounds you hear in?" Response: make_____(m-ā-k)*

Adding Phonemes to the beginning or end of words safe kit vest

Say: *"Say (- afe). Add /s/ at the beginning. Say the new word." Response:"safe"*

"Say (-it). Add /k/ at the beginning. Say the new word." Response:"kit"

"Say (-est). Add /v/ at the beginning. Say the new word." Response: "vest"

Deleting Phonemes fuzz kit yell

Say: *"Say 'fuzz'. Say 'fuzz' without /f/. What's left?" Response: /-ŭz/*

"Say the word 'kit'. Say 'kite' without saying /k/. What's left?" Response: /-ĭt/
"Say theword 'yell'. Say 'yell' without saying /y/. What's left?" Response: /-ĕl/

Substituting Phonemes chop cram good

Say: *"Say 'chop'. Take away /ŏ/and change it to /ĭ/. The new is?" Response:"chip"*
"Say 'cram'. Take away /m/ and change it to /b/. The new word is?" Response: "crab"
"Say 'good'. Take away /g/ and change it to /h/. The newword is?" Response: "hood"

2. Introduce the GPC of the day (10 minutes):

Show the students the letter-sound card a_e.

Say: *"These are the letters a and e. The letters a and e says /ā/. Say the sound with me: /ā…/."*

Show the students the target words.

Say*: "We can read words by sounding them out. Look at each word, listen to how I read them, then repeat after me."*

Show each target word one word at a time. Say the word aloud emphasizing the letter-sound /ā/. Have the students look at each word and repeat it back to you.

Regular Word Practice

Distribute one set of letter-sound cards to each student. Have the students lay the cards face up in front of them, then search for the letters m, a, d, e, and c.Tell them to place the rest of the letter-sound cards to the side.

Say: *"Let's blend these sounds together! Notice that there are three sounds. The long /ā/ sound will be in the middle of the word."*

Using the letters m, a, d, and e model how to blend the sounds /m/, long /ā/, and /d/ together to decode the word *made*. Place your finger under the 'm' letter-sound card as you say its sound: /m/. As you are saying its sound, move your finger to the next letter card and say its sound /ā/, then to the last letter card and say its sound /d/. Go back to the first letter and continuously blend the three sounds together /m-ā-d/ as you move from the first to the last sound /d/.

Say the word (made). Go back to the beginning and repeat the process again,continuously blend the first sound through to the last sound.

Say: *"Now it's your turn! Blend the sounds together."*

Have the students find the letter-sound cards c, a, m, and e. Using these letter-sound cards, ask them to say the sound of each letter, /c/-/ā/-/m/.

Say: *"Let's try reading another word."*

Watch and listen as the students blend. Model correct pronunciation and provide corrective feedback as needed. Have the students practice blendingthe same word multiple times, making sure they place and glide their finger under the letter-sound cards while blending aloud.

Repeat the continuous blending strategy to read other target words (lame, save, snake, and shape).

Modification: Provide the students with letter-sound boxes to help them visually organize the placement of letters and movement from the beginning to the end sound of the word.

Extension: For more-able readers, have them use the letter-sound cards to blend and read words on their own or with a partner. If the student is ready, they may write the letters as they blend them together to spell the word.

3. Irregular Word Practice (5 minutes):

Introduce irregular words of the day: large, largest

Mindy the

Morpheme Detective

Provide the following text to the students. Together, read the following text aloud.

The blue whale is the largest animal in the world.

Morphological Analysis

Write the word *largest* on the whiteboard.

***Step 1* - What does the word mean?** (Define the word and use it in a sentence.)

Say: "Let's be word detectives! Find the word *largest* in the sentence we just read." Students find and underline the word *largest*. "What does the word *largest* mean?" (Answer: of great size or considerable capacity) "Can you use the word *largest* in a sentence?" (e.g., What is the largest fish in the sea?) Provide another sentence example if needed.

***Step 2* - How is the word built?** (Identify any bases or affixes in the word.)

Say: "How do you think the word *largest* is built? Can you find the base of the word *largest*?" (Answer: large) "Can you find the prefix or suffix in the word *largest*?" (Answer: -est).

Ask the students to tell you how to write the word sum for *largest.* ***(large + est→largest)***. Have the student write out the word sum as they spell it out on their whiteboards. (l – a – r – g – e – plus -e-s-t is rewritten as l-a-r-g-e-s-t).

Say: "What do we need to check?" (check for suffixing changes) "Does the suffix begin with a vowel letter?" (yes). "Does the base have a final, silent <e>?"(yes). "What do we do?" (Replace the e, add -est).

***Step 3* - What other related words can you think of?** (Morphological relatives –identify words that are connected by the base.)

Say: "Are there any other words that you know that also have the base word *large*?" (Answers: larger, largely, enlarge, enlarges, enlargement) Spell out the letters as you write the words on the whiteboard.

Step 4 - What are the sounds that matter? (What grapheme-phoneme correspondences can you find? Note: pronunciation shifts and/or irregularpronunciations.)

Say: "What are the sounds that matter? The letter <g> in the base *large* is pronounced as /j/."

4. Shared Book Reading (10 minutes):

Using the text that you have selected for shared book reading, interactively read the text aloud, pausing at different places to help the students identify and read words that contain the letter-sounds. The students should be encouraged to read words they already know or have learned in the lesson.

5. Wrap Up (2 minutes): Ask the students to say the letter-sound of the lesson and read the irregular words they learned.

Lesson 30 – Letter-Sound Card <a_e>, long /ā/

Lesson 30 – Regular Word Cards <a_e>, long /ā/

made	came
save	lame
snake	shape

Lesson 30 Irregular Word Card <a_e>, long/ā/

large

Lesson 30 – Letter-Sound Cards <a_e>, long /ā/

m	a	d
e	c	s
l	n	k
sh	p	v

Appendix D

CONDITION 2 – PHONICS + MORPHOLOGY REVIEW LESSON SAMPLE

Lessons 28-30 (<ar> /ar/, <er> /er/, long <a> /ā/)

Objective:

Students will review decoding words that contain the learned Grapheme Phoneme Correspondences (GPCs).

Materials:
Letter-sound cards
Target-word cards
Selected text for shared word reading
Morpheme Morph activity sheet (Lessons 28-30)
Spot it! Swat it! Say it! (Appendix C)

Before beginning the lesson, select target words from the previous lessons that need review. These words should include target words that have yet to be mastered and the all the irregular words.

Instructions

1. Review the letter-sounds, target, and irregular words (3 minutes)

First, show the students the individual letter-sound correspondence cards and ask them to tell you the name of each letter and the sound it makes (e.g., short u says /ŭ/). Next, select a number of target words from the previous lessons. Place one word in front of each student and ask them to blend the sounds together to read the word. Repeat with more words. These may be target words that were not decoding or challenge words in the previous lessons. Differentiate depending on the students' levels. Finally, present the irregular words previously covered and ask the students to read them. Mix up the cards and repeat.

2. Word Work – Spot It!, Swat It!, Say It! (7 minutes)

Materials

Sound/Word cards from previous lessons or

Spot it! Swat it! Say it! cards or word cards from previous lessons
Sound/Word swatters (Appendix C)

Activity

Before beginning the game, pre-select, print and cut out the sets of sound and/or word cards you want students to practice. For durability, print the sound/word spot cards on cardstock and laminate.

1. Pass out a swatter to each child.

2. Spread a variety of sound and/or word cards across a table.

3. The game begins when you call out a sound and/or word.

4. The students search for the sound and/or words, then slap them with their swatters.

5. Encourage the students to repeat the sounds or words they swat before moving onto the next one.

6. Play continues until the students have had multiply opportunities to spot, swat and say a variety of sounds and/or words.

Alternatives to dictating sounds/words

- Slap a word that the /t/ sound.
- Slap a word that has the /v/ sound.
- Slap a word that has 3 sounds (e.g., box)
- Slap a word that begins with /sh/.
- Slap a word that end with /sh/.
- Segment a word for the students to find (e.g. /v/-/a/-n/).
- Slap a sound that is made by two letters (i.e., /sh/).

Say: "How many words can you spot and swat? Look at the words spread across the table. When you spot the word I say, swat it with your swatter!"

Dictate a word to the students.

Modification: To make the game easier, reduce the number of target sound/word spot cards spread on the table. Begin with the sound cards first, and then progress to words that contain a similar letter-sound correspondence.

Extension: To make the game more challenging, increase the number of sound and/or word spot cards to be identified. Include a mixed set of sound and/or word cards for the children to read. These may include words from previous lessons.

3. Morpheme Morph (10 minutes)

Select a Morpheme Morph activity sheet from Lessons 28-30 to complete with the students. Distribute one activity sheet per student. The example providedhere is Lesson 30 – *large*, *largely*

Demonstrate how to read the Word Matrix (see introduction for detailed instructions). Read and explain what is displayed on the page (i.e., the Word Matrix and the Word Sum). Read the morphemes (prefixes, base, suffixes) together before writing.

Say: "We can use the Word Matrix to help us build Word Sums.

Provide a concrete example. Write as you spell-out the first word sum together.

Say: "We can build the word *largely*. Can you find the base of the word *largely* on the Word Matrix?" (largely) "What should we add to the base *large* to build the word *largely*?" (the suffix -ly) "Is there a suffixing change?" (No. Since we are adding a suffix that does not start with a vowel, we can just add it to the base.)

Have the students write on the activity sheet as they spell-out the action of building the Word Sum. This process will require explicit modeling and practice until they become comfortable with reading the Word Matrix and spell-out as they are writing.

Say: (If needed) "What morpheme should we write on the first line?" (the base *large*) "What morpheme should we write on the second line after the plus sign?"(the suffix -ly) "Let's spell-out the word wum as we write."

l-a-r-g-e plus -l-y is rewritten as

l-a-r-g-e-l-y

large + ly → largely

Check that the word is spelled correctly and that all the steps have taken place in the Word Sum (e.g., remember to cross out the silent <e> when you say no 'e'!). Repeat the process until the activity sheet is complete.

Modification: Provide the students with multiple examples. If a student is severely struggling with writing-out, they may spell-out the word sum as you write it on the paper or on the whiteboard.

Extension: For more-able readers and spellers, they may complete another lesson sheet and/or be given additional polymorphemic words to build word sums on their own.

4. Shared Book Reading (10 minutes):

Using the text that you have selected for shared book reading, interactively read the text aloud, pausing at different places to help the students identify andread words that contain the letter-sounds. The students should be encouraged to read words they already know or have learned in the lesson.

Morph the Morphemes

Write Word Sums with the Base <large>

en	**large**	ed er es est ing ly ness	
		ment	s

_____	+	_____	+	_____	→	_____
prefix(es)		**base**		suffix(es)		word

_____ + _____ → _____

_____ + _____ → _____

_____ + _____ → _____

_____ + _____ → _____

_____ + _____ + _____ → _____